A PRELIMINARY INVESTIGATION OF THE EFFECTS OF POLYTHENE ON ASPHALT PAVING MIXTURES.

by

Brian P. Shields 1956

ABSTRACT

This report contains the results of a preliminary investigation of the effects of polythene on asphalt paving mixtures.

A brief outline of modern concepts in asphalt paving technology is presented with reference to the prior research which has formulated these concepts. Present research, mainly from the viewpoint of increasing the durability of high class pavements is discussed, with especial reference to contemporary investigations of rubberized-asphalt.

The physical and mechanical properties of commercial polythene are presented together with a discussion of how these properties might prove beneficial in asphalt pavements.

Preliminary results showing the effect of polythene on the rheological properties of asphalt cements are presented. The physical magnitude of these changes was assessed by an investigation of certain fundamental properties of compacted asphalt mixtures at various conditions of age, temperature and additive content.

A general analysis of this data is presented, together with an appraisal of the techniques utilized, and a discussion of the results indicates how the observed effects might prove beneficial in asphalt pavements.

It is concluded, from the preliminary investigation undertaken that the improvements observed, while slight, justify further research upon certain specific lines.

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A PRELIMINARY INVESTIGATION OF THE EFFECTS OF POLYTHENE ON ASPHALT PAVING MIXTURES

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GLOSSARY OF TERMS

Asphaltic Bitumen and Bitumen - a dark, highly viscous to almost solid substance, consisting of hydro-carbons and their derivatives. It is the residue of certain kinds of petroleums after the evaporation of their most volatile components.

Asphalt, Paving Grade Asphalts - refers to the soft Asphalt Cement asphaltic bitumens generally used in hot-mix asphalt and concrete paving.

Asphaltic Concrete - refers to the intimate mixture of asphalt cement and well graded inert granular materials normally associated with high class, heavy duty flexible pavements.

Aggregate - the particular combination of inert granular particles used in combination with asphalt cement to form asphaltic concrete.

Asphaltenes - the high molecular weight concentrations of the micelles, soluble in carbon tetrachloride.

Cracking (of Asphaltic Bitumens) - the process by which an asphalt is destructively distilled.

Oxidation - refers to the reaction of asphalt with atmospheric oxygen, resulting in a hardening of the asphalt through a change in the ratio of asphaltenes to maltenes.

Rheology, (Rheological) - refers to the flow and deformation properties of matter.

Penetration - refers to the consistency of asphaltic bitumens (Normal Penetration) as measured by A.S.T.M. Standard Method of Test For Penetration of Bituminous Material D-5-52.

Ductility - refers to the consistency of asphaltic bitumens as measured by A.S.T.M. Standard Method of Test For Ductility of Bituminous Materials D-113-44.

Softening Point - (or Fusing Point) - refers to the consistency of asphaltic bitumens as measured by A.S.T.M. Standard Method of Test for Softening Point of Bituminous Materials (Ring and Ball Method). D-36-26.

Maltenes - the lower molecular weight constituents of the micelles (or dispersed phase) of asphalt cements.

Petrolenes and Resins - the lighter molecular weight constituents of the intermicellar phase (the continuous phase) of asphalt cements.

CHAPTER I

INTRODUCTION

One of the most important cornerstones in the economic structure of a modern nation is a well developed system of adequate transportation facilities - highways and airports. The dependence of our present day way of life on these facilities is emphasised clearly by the large proportion of public funds that is allocated annually to the construction of new highways and to the maintainance and improvement of existing roads.

Modern paved surfaces can be divided into two categories; rigid (Portland cement concrete) and flexible (asphalt). Both must satisfy several criteria of performance in order to be economically feasible, including the ability to transmit superimposed wheel loads in such a manner that the supporting strength of the underlying base is not exceeded. Also, the paved surface, if adequately supported, must be sufficiently stable,itself, exhibiting no displacement under load. Thirdly, the surface must be sufficiently durable, with adequate resistance to the abrasive effects of traffic, and the effects of severe climatic conditions, for a reasonable period of time.

It is not intended here to enter into an evaluation of rigid pavements versus flexible pavements. However, it should be noted that the above mentioned criteria are satisfied more completely by the former than the latter, but since a flexible pavement is cheaper initially, efforts directed towards the improvement in quality of such surfaces are fully justified.

* Figures in parentheses refer to references contained in the bibliography.

Asphalt pavements have been in use for over a century (1), but a strictly scientific approach toward their design, construction and evaluation has been evident only for the last thirty years or so. Unlike other construction materials such as concrete and steel, the properties of asphaltic mixtures, which are affected to such a large extent by minor changes in temperature and rate of loading, and by exposure to the elements, are not well understood and engineers still resort to empirical and semi-empirical design and test methods.

Before entering into a discussion of the modern concepts of asphalt pavements, it would be advisable to consider briefly the function of the bituminous binder in an asphalt pavement. The physical and chemical properties of asphalts per se are available in the literature (1), (2), and will be reviewed herein only where necessary to obtain a more complete understanding of the scope of this investigation.

According to Hveem, as quoted by Gregg (3)"....... any adhesive, semiliquid material which can be made sufficiently fluid to permit mixing with the aggregate, which will adhere well to the stone in the presence of water, and which will not become brittle with age, will make a suitable binder for a road surface". The bituminous binder has several functions then. Primarily it is the cementing medium which maintains the inert aggregation in a stable structure. It must remain sufficiently cohesive in the presence of water, so that the intimate structure obtained in construction is not lost due to stripping of the thin asphalt films from the surface of

the particles. The requirement that the bitumen will not become brittle with age is based on the fact that asphalt reacts with oxygen at atmospheric temperatures, and that the rate of oxidation is accelerated by exposure to light. The degree of oxidation depends on the specific surfaces exposed to the air and the temperature of the reaction. (2). The process of oxidation causes an increase in the asphaltenes, and thus an increase in the brittleness of the asphalt. Physically, this may be interpreted as a decrease with age in the ability of the thin asphalt binder film to flow plastically without rupture when subjected to stress. Also since asphaltic bitumen is thermoplastic its consistency varies with temperature. Thus a fourth necessary function of the bituminous binder, is that it will be sufficiently stiff at elevated atmospheric temperatures, that it will not allow the pavement to flow plastically under the external loads. Conversly, at low temperatures, the asphaltic bitumen should not become so hard that the paved surface will fracture under applied loads or under thermal stresses. This fourth requirement is perhaps the most difficult one to meet in an asphalt pavement since it demands two opposite reactions from the bituminous binder. A compromise must be effected, which is usually in favor of providing sufficiently high resistance to plastic flow at elevated temperatures by the use of a relatively stiff asphaltic bitumen, with a resultant sacrifice in flexibility at low temperatures.

Until comparatively recently, a major portion of asphalt paving in this country and the United States was done using relatively stiff bituminous binders, with penetrations of about 60 or less, in order that plastic flow in the pavement as evidenced by tire printing, rutting and shoving, would be avoided. However, it was observed that many of these pavements exhibited considerable cracking after relatively short periods of service. Numerous investigations (4) showed, that where failure could be attributed to the asphaltic bitumen, and not to other factors such as poor construction, etc., it was due to the fact that the binder had become excessively hard during and subsequent to the mixing operation. This increase in hardness was indicated by a drop in penetration and ductility and an increase in the softening point (5), mainly due to excessive oxidation of the thin bituminous binder films, during the actual mixing process. The effect of brittleness in the asphalt binder is increased at low temperatures, and Rader, in his early studies of the low temperature properties of compacted asphalt mixtures, concluded that "All other factors being equal, it would appear that those mixtures containing the highest penetration asphalt consistent with necessary stability should prove most resistant to cracking at low temperatures" (6). He also advocated using the largest asphalt content possible consistent with the required stability, as the toughness of the mixtures at low temperatures was greatest at high binder contents (7).

It is obvious then, that the term "durability" when applied to an asphalt pavement is a fairly generalized one, since the paved surface must satisfy several criteria in this respect. In addition to being sufficiently stable at high temperatures, and not too brittle at low temperatures, a durable pavement must also be sufficiently resistant to the abrasive effects of traffic, adhere strongly to the aggregate in the presence of water, and provide a sufficiently rough surface texture to eliminate skidding. The latter three requirements are dependent mainly on the quality of the inert aggregate used in the mixture though the importance of the asphaltic bitumen cannot be ignored. Finally, a satisfactory pavement must be flexible. That is, it must possess the ability to conform to the shape of the supporting base without rupture. The flexibility of a bituminous mixture is affected by the quantity of asphalt binder, the viscosity of the binder and the number of inter-particle contacts in the compacted mixture. It cannot be treated separately from the requirements for stability.

As a result of such investigations as mentioned previously, and through a process of trial and error, the problem of providing a sufficiently stable asphalt pavement, resistant to displacement even under the heavy wheel loads in existence today, has been solved at least in part. More reliance is placed on the gradation of the aggregate and the degree of compaction to be reached. The asphalt content is held to a minimum consistent with good compaction

and, of course, consistent with the other requirements of the mixture. Several design methods are in existence, many of which are emperical, and all subject to improvement (8). Unfortunately, all these design methods must be treated with caution and often modified by experience. This is especially true when considering the requirements of durability, since these currently advocated procedures emphasise stability - a cardinal feature - but not the only one.

The reasons for this current emphasis on the stability of asphalt paving mixtures are three-fold. Firstly, the advent of the Second World War called for immediate, world wide expansion of airport facilities capable of handling the immensely heavy wheel loads of modern aircraft. The question of durability was of secondary importance since the emphasis was on the immediate construction of fields in forward areas whose period of use would be quite short. The Marshall Stability Test, as developed by the U.S. Army, Corps of Engineers (9) is a prime example of this type of stability test. Secondly, the large increase in highway traffic and the increase in truck wheel loads in the past decade has required more stable pavement design, and the results of wartime experience can be applied directly to this problem. Thirdly, durability in general can only be assessed fully over a relatively long period of time, possibly the full life of the pavement, unless resort can be made to full size test tracks which are relatively expensive. To date there is little agreement on a simple, accelerated durability

test that can be used on a laboratory scale, due to the complexity of asphaltic bitumen itself (2) and the many factors involved in the definition of durability. (10).

The present day trend in asphalt paving technology then, as based on the vast amount of experience accumulated within the last forty years or so, is to provide maximum stability by the use of dense, well graded granular materials and to obtain a high degree of compaction. Also, as high a proportion of asphalt cement as consistent with stability requirements should always be used. Mixtures should be prepared at the lowest possible temperatures practicable. These requirements are expressed in a qualitative sense only, and the major problem is to put them on a quantitative basis.

By the use of well graded selected aggregates the required stability may be provided largely by the internal friction of the granular material - a mechanical action. The asphaltic bitumen then plays a minor role, in the form of cohesion. Thus, with resistance to displacement provided mainly by the inert aggregate, a softer asphaltic binder may be utilized. Then, with an initially softer binder, and using as low mixing temperatures as practicable, the possibilities of excessive oxidation occuring during the mixing process are reduced. By providing as high an asphalt content as commensurate with adequate stability, the films of asphalt surrounding each particle of aggregate will be thicker, reducing the effect of oxidation in service. A high degree of compaction is desired in order to reduce the amount of surface area exposed to the air, thereby further decreasing the rate of oxidation.

However, despite marked improvements in the design and construction techniques involved in the building of high-class heavy duty asphalt pavements, and great advances in our knowledge of the properties of asphaltic bitumen, there is still much to be desired in the improvement of such pavements. The major problems at present are still to provide adequate flexibility at low temperatures and to prolong the life of the pavement. With the depletion of good aggregate deposits in some parts of the country, and recourse to inferior sources the problem of providing adequate stability is still present. The solution to these problems must lie in improvement of the qualities of the asphaltic bitumen, or expansion of our knowledge of the properties of asphalts in order that we may use them more intelligently.

CHAPTER II

SOME ASPECTS OF PRESENT RESEARCH INTO THE IMPROVEMENT OF ASPHALT PAVING MIXTURES.

Research into the possible improvement of asphaltic bitumen has fallen into two general categories. The first, and the basic approach, has been an assessment of the fundamental properties of asphalts and their relationship to temperature and time. Work along this line is hampered by the fact that asphalt itself is a most complex substance. Asphalts are known to be complex colloidal substances consisting principally of compounds of a predominantly hydrocarbon nature. Their composition and structure are not fully known, as no clearly defined segregation of the basic constituents has been obtained to date (2).

However, a great deal of knowledge of the rheological properties of asphaltic bitumen has been obtained through the use of emperical testing procedures such as the penetration,ductility and softening point tests, (1) and the use of viscosity tests in various forms. These test methods were devised to assess the consistency of asphalt, and though most are strictly emperical, they are extremely useful in expressing this consistency in simple terms. Further, the change in values obtained by these methods with a change in temperature, or with ageing of the asphalt give a qualitative idea of the change in properties of the asphalt. These qualitative values, often expressed as "susceptibility indices" (change in value or penetration, viscosity, etc., with change in temperature, or age) have

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been correlated with service performance of asphalt pavements in an effort to differentiate between asphalts exhibiting good performance characteristics and those which do not perform as well. In addition, the effects of refinery techniques have been investigated thoroughly. The literature abounds with the reported results of such investigations, but only generalized conclusions may be derived from such data due to the fact that the rheological properties of asphalts may vary considerably according to source and process of manufacture (1). An indication of the scope and magnitude of such investigations may be found in the recent comprehensive studies of Neppe (11,12). While such studies are valuable from a generalized viewpoint, in that they tend to emphasize certain fundamentals such as the superiority of uncracked asphalts over cracked asphalts, and the use of as soft a binder as is consistent with stability requirements, etc., they are dependent to a large extent upon either accelerated ageing methods devised in the laboratory, or upon field observations of the actual service performance of the material. The former may bear little resemblance to the actual weathering process encountered in service, while correlations derived by the latter method may be modified or even obscured by conditions other than the actual weathering and ageing process.

A second approach to the problem of improving bituminous mixtures as regards their durability is through the incorporation of various compounds into the bitumen. The additives in question range from the anti-stripping "dopes" such as

montan wax and contain organic amines (2), to cotton and jute fabrics impregnated in asphalt. Although the latter are not, strictly speaking, additives, they do emphasise a recurring problem - that of imparting a greater inherent tensile strength to the asphalt surface. In recent years glass fibres, and asbestos fabrics have been incorporated in canal linings, and wire mesh reinforcing has been used in many road resurfacing projects, all in an effort to promote longer life to the pavement, through the reduction of cracking in the surface.

Mineral fillers (limestone, cement, talcum) are sometimes incorporated in an effort to increase the viscosity of the asphalt at the processing temperature (1,2).

In recent years, considerable interest has been devoted to the incorporation of rubber in bituminous paving mixtures. (3, 13, 14). It was felt that the properties of rubber when dissolved or partially dissolved in asphalt might tend to increase the durability of the bitumen, and thus increase the life of the pavement. The general trend is to increase the elasticity, hardness and fusing point of the material. Whether such changes are beneficial from the view point of increasing the durability of an asphalt pavement are still the subjects of considerable research (15). However, the results of investigations to date show that the additions of some forms of rubber to asphalt mixtures produce an increase in the toughness of the mixture (capacity for energy absorption) and a decreased susceptibility to temperature change by virtue of a decreased viscosity at low

temperatures and an increased viscosity at high temperatures (15). It should be noted that these beneficial effects are reflected by a decrease in penetration, a decrease in temperature susceptibility, an increase in the softening point, and a marked decrease in ductility. A decrease in penetration combined with a decrease in the temperature susceptibility is desirable in that initially softer bituminous binders might be incorporated beneficially in an asphalt mixture, combining adequate stability at elevated temperatures with less, or at least, no increase in brittleness at low temperatures. An increased softening point also points to an increase in stability at elevated temperatures. The marked decrease in ductility noted (14) would seem undesirable in the light of what has been said previously. Gregg, in ref. (15) mentions, quite significantly, that in dealing with rubber-asphalt mixtures, "new ranges of penetration, ductility, softening point, viscosity, and the like, must be associated with measured characteristics of compacted mixes, such as stability, durability or flexibility before their significance with respect to asphalt-rubber binders could be established". In view of the increased resistance to flexure-fatigue (a laboratory method designed to simulate long term intermittent loading and weathering on compacted rubber-asphalt-aggregate mixtures) noted in the specimens, the decreased ductility observed does not appear as significant as it does with ordinary asphalts.

Recently, patents have been issued relating to a method of improving asphaltic bitumen by incorporating polythene into the mixture (16). The claim is that the polythene reduces

the brittleness of the asphalt when incorporated in amounts ranging from 5% to 30% by weight. This improvement in brittleness characteristics is reflected by a slight increase in softening point and substantially no change in the penetration of the material. It should be noted that the method refers to improving the qualities of extremely hard bitumens (penetration values less than 10) such as are used extensively in coating metals for corrosion protection, for impregnating papers and textiles, and as electrical insulating compounds.

The question arises, then "What would be the effect of polythene on the soft asphalt cements commonly used in high class asphalt pavements, and what would be the ultimate effect on the properties of paving mixtures themselves?". This dissertation contains the results of some preliminary investigations into this problem.

First, it is profitable to outline the properties of polythene, in order that a more complete understanding of the problem may be attained. Polythene (or polyethylene) is a high molecular weight polymer of ethylene, possessing a unique combination of toughness, chemical inertness,flexibility at low temperatures, resistance to water and water vapour, and outstanding electrical properties. The variation in character of ethylene polymers depends primarily upon two factors - the average molecular weight and the crystallinity.

The tough, flexible polymers (polythenes) have molecular weights in the range of 10,000 to 50,000 and consist of highly branched, long chain molecules, giving rise to ordered, or crystalline regions known as crystallites. The branched

structure prevents an ordered arrangement along the length of the molecular chains.

Upon heating, the crystalline structure of polythene changes, the material attaining a completely random structure at about 250°F (115°C), becoming a viscous melt. Rapid cooling affects the resultant structure less than slow cooling, the latter process giving a more rigid and more brittle structure.

The viscosity of molten polythene increases with molecular weight and is a convenient property for classifying the material. Grading of polythene may be accomplished by use of a "melt index", a low melt index corresponding to a high viscosity (and thus a high molecular weight). (17).

The mechanical properties of polythene vary according to molecular weight, but the variation is not large in the standard, commercial grades. Tensile strength and shock resistance vary little with grade, whereas the flexibility at low temperatures increases rapidly with increasing molecular weight. Table A is reproduced in part from Ref. (17) to show the actual magnitude of the physical factors involved.

It should be noted that the actual mechanical properties of polythene are time-dependent. Also the shape of the stress-strain curves depends on the temperature, as well as the rate of the strain.

PROPERTY	"ALKATHENE" Melt Index — 0.2	0.7	2	7	20	Notes
Tensile Strength						
I.C.I. Tests at 68^{o}F						
Yield Point psi	1700	1560	1490	1420	1420	
Break Point psi	2500	2300	2200	1850	1560	
A.S.T.M. Ultimate Tens. Strength at 73^{o}F psi			1700	1280	1070	
Elongation at Break %						
I.C.I. Test	600	600	550	500	450	
A.S.T.M. Test			660	430	340	

Low Temperature Brittle Point						
I.C.I. Test ^{o}F	-148	-112	-94	-40	-22	
A.S.T.M. Test ^{o}C	Below -80	Below -80	Below -80	-80	-43	

TABLE A

Mechanical Properties of Commercial Grades of Polythene.

(Reproduced from Ref. 17.)

As regards thermal properties, the commercial grades of polythene all melt at 111°C (232°F). The temperature at which these materials soften varies with the molecular weight. By the Vicat Test (17) the highest molecular weight polythene shown in Table "A" has a softening point of 98°C (208°F), while the lowest molecular weight material has a softening point of 83°C (181°F).

Polythene is extremely resistant to most common acids and alkalis, and is relatively insoluble in most organic solvents, below 60°C (140°F).

It is seen that polythene possesses relatively large tensile strength and the ability to undergo extremely large deformations without rupture at normal temperatures. Also, the material retains great flexibility at extremely low temperatures. If these properties could be imparted to an asphaltic bitumen, it would appear that the properties of an asphalt mixture could be enhanced greatly, as regards strength and durability, especially with respect to flexibility at low temperatures.

The problem then becomes quite complicated when we consider adding a material such as polythene to the complex colloidal structure of asphaltic bitumens, and the actual relationships and interactions of the two is a problem in organic and physical chemistry. However, from a practical engineering viewpoint, it is possible that the effect of polythene on the properties of asphaltic bitumen may be assessed by the classical emperical methods used heretofore

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in evaluating the rheological properties of asphalts themselves, and correlating the observed changes in properties with the actual physical data derived from other sources or further experimentation. Up to now this has been the approach used in research on the effects of rubber in asphalt pavements (15), and appears a most logical one, in view of the difficulties encountered in even analysing the constituents of asphalts (2).

As stated previously, the object of the research reported herein was to obtain some preliminary data on the effects of Polythene on asphalt paving mixtures. The words "preliminary" and "asphalt paving mixtures", are stressed for two reasons. First, the problem of incorporating certain commercial forms of polythene in aspahltic bitumen is a major one in itself, as was emphasized in the preceeding paragraph, and as observed during the course of investigation reported herein. Secondly, it seemed desirable to obtain, as early in the investigation as possible, actual data on the changes (if any) in the physical properties of compacted asphalt paving mixtures when polythene was incorporated with the binder. This was desirable for two reasons, also. One was that there is very little data in the literature showing correlation between the rheological properties of asphalts as measured by the penetration test, ductility test, softening point test, etc., and certain fundamental characteristics of compacted paving mixtures - shear strength and tensile strength. Second, it was felt necessary to obtain some quantitative data on the magnitude of the effects observed, in order to direct future research along the most profitable lines.

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The investigation was organized on the following basis therefore;

(i) A preliminary investigation of the mixing process, in order to obtain a fairly simple method of incorporating the polythene with asphalt cements of paving grade, for this initial study.

(ii) Assessment of the rheological properties of the asphalt-polythene mixtures by penetration, softening point and ductility tests.

(iii) Assessment of the shear strength and tensile strength of a typical, compacted asphalt paving mixture containing asphalt-polythene binder, to see whether observed changes in rheological properties were reflected in an actual mixture, and to obtain some quantitative data on the magnitude of such effects under certain conditions of artificial age and temperature.

It is immediately apparent that many factors relating to the improvement of bituminous paving mixtures, especially from the viewpoint of improvement of durability characteristics, have been omitted in the program outlined. However, it was deemed essential that these basic factors be evaluated first, before detailed studies were commenced, in order to eliminate needless waste of time and effort at later stages, and to provide a sound basis for future research along all lines.

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CHAPTER III

PRELIMINARY STUDIES ON MIXING POLYTHENE WITH ASPHALT

For this preliminary study, three distinct grades of commercial polythene were provided. Their significant properties are outlined in Table B, below. It can be seen,

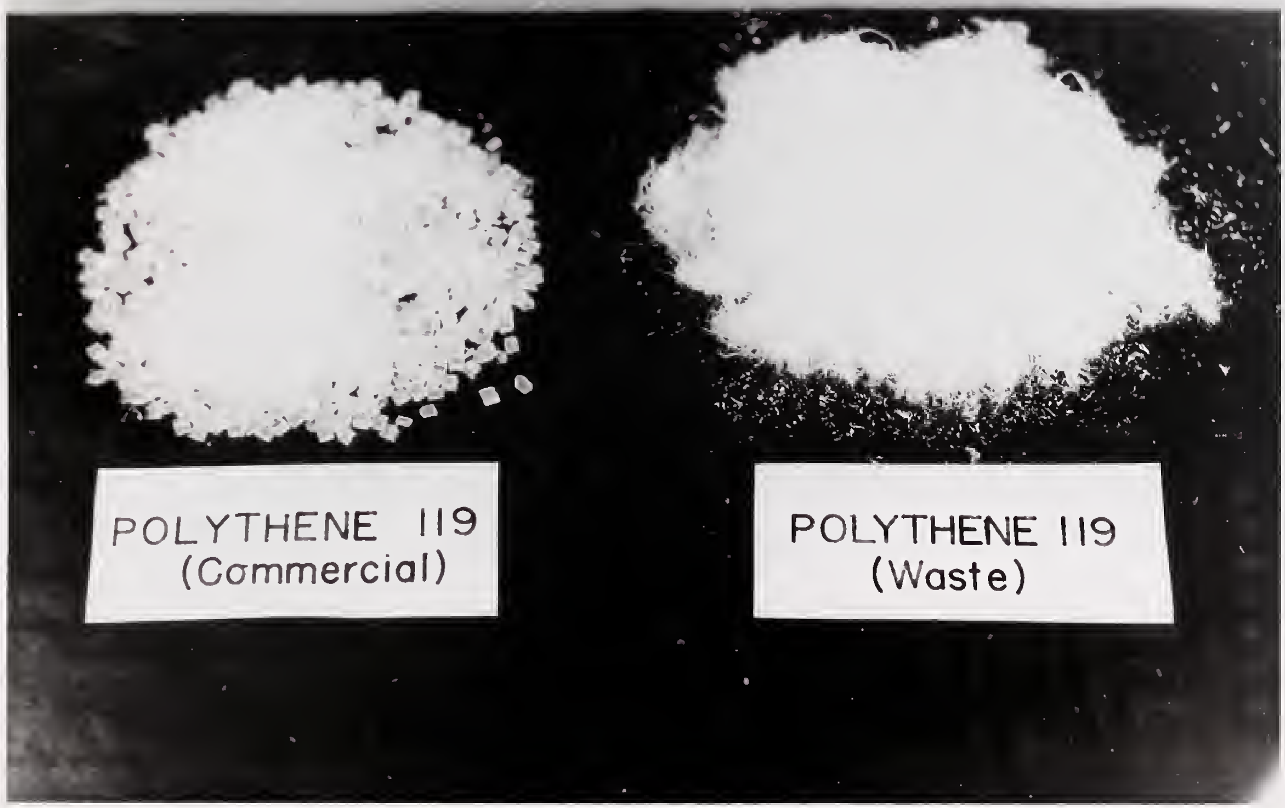
Lot #	63	119	2461
Melt Index	160	4.2	0.38
Environmental Crack Resistance	-	2-4 hrs	>300 hrs
Low Temperature Brittleness	-20°C	-83°C	<-83°C
Ultimate Tensile Strength	1030 psi	1600 psi	2300 psi
Yield Strength	1030 psi	1470 psi	1550 psi
Elongation (at Rupture)	80%	560%	790%
Vicat Softening Point	57°C	86°C	89°C
Density	-	0.915	0.918
(Molecular Wt.-Range) x 10^3	18-14	32-28	44-37

TABLE B - Physical Properties of Polythene Used in Investigation

with reference to Table A that the three materials provided covered practically the complete range of commercial polythenes, with Lot 119 near the middle of the range. Hereinafter, the three types will be referred to by Lot number. The polythene came in the normal cube-cut granule form, as shown in Plate I.

Two grades of Asphalt Cement were used in this initial study - penetration grade 100-120 and penetration grade 200-300. The asphalt was uncracked, and was selected solely on the basis of availability.

It should be noted that at this early stage in the investigation, it was felt necessary to reduce possible test



POLYTHENE CUBE-CUT GRANULES AND POLYTHENE FIBRES

PLATE 1.

[illegible]

[illegible]

variables to a minimum, and for this reason, only the two grades of asphaltic bitumen mentioned, from a single source, were utilized.

To assess the change in rheological properties of paving asphalts with the inclusion of polythene, it was decided to use three basic, emperical consistency tests that enjoy wide use in the field of asphalt technology. These were:-

(i) A.S.T.M. Standard Method of Test for Penetration of Bituminous Materials. D-5-52.

(ii) A.S.T.M. Standard Method of Test for Ductility of Bituminous Materials. D-113-44.

(iii) A.S.T.M. Standard Method of Test for Softening Point of Bituminous Materials (Ring and Ball Method) D-36-26.

A fourth test method employed by Endres et al (13) called the "cold flow" test was considered, but some initial observations showed that the method was not precise enough in this case, nor were results consistent, so the test was abandoned.

Penetration is the normal criterion of consistency of asphaltic bitumens and has a wide measuring range. The determination of penetration, (which is merely the depth that a standardized needle penetrates a sample of asphalt under standardized conditions of time, temperature, and load) is substantially a measurement of resistance to deformation, and is closely related to the viscosity.

Since asphaltic bitumens have no real melting point, and when heated, gradually become softer any determination

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of softening point is bound to be arbitrary. The method used herein defines the softening point as the temperature at which a sample of bitumen, enclosed in a brass ring, is extruded a specified distance by a small steel ball when the whole system is heated at a specified rate. It is a measurement of the relative mobility of asphalts at elevated temperatures, aspahltic bitumens all having about the same viscosity at their Ring and Ball Softening point. (2).

The ductility test measures, empirically, the amount an asphaltic bitumen may be stretched without rupture, under standardized conditions of rate of elongation, specimen dimensions and temperature.

Basically, polythene could be introduced into an asphalt mixture in two ways. First, it could be introduced as a powder, to asphalt-aggregate mixtures, thus forming part of the aggregate fraction. This seemed undesirable on several counts. In order for the polythene to retain its original character, it would be necessary to introduce it to the mixture at a temperature below its melting point (232°F) which is somewhat below the temperatures normally employed in hot-mix asphaltic paving. Existing as merely a part of the aggregate fraction, the amount of polythene economically feasible would occupy a very small fraction of the total volume of the mixture; in addition the additive would exist as separate, discrete particles with no structural bond to one another except through the binding medium. Also, the dispersion of the particles might not be homogeneous. Research in rubber additives (14, 15) indicates that incorporation of the

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material in the form of a powder has not been successful, to date, for essentially the same reasons given here.

The second method of adding polythene to asphalt, would be to melt the former in the latter and disperse it thoroughly, so that a uniform mixture would be obtained. Such a mixture would then be added to the inert aggregate, as an ordinary binder would be. This second approach has been followed, with some modifications, in this investigation.

The mixing process was accomplished with a Cenco Variable Speed Stirrer, operating at approximately 100 rpm, and actuating a broad paddle-type blade. The asphalt cement was heated in an aluminum pot to the required temperature. The polythene granules were then added slowly as the mixing process continued. The process is admittedly crude, and would be subject to considerable modification in future investigations.

Although the results of this phase of the investigation are not conclusive, since the mixing studies were directed mainly towards finding a quick and simple method of adding polythene to asphaltic bitumen so that fundamental data on the properties of actual mixtures with a polythene-asphalt binder could be obtained, a resume of the main points of the investigation is included here, in order to point out some of the problems encountered, and to help direct future investigations along this line.

Initially, it was attempted to add the polythene to the hot asphalt cement at temperatures normally encountered at asphalt paving plants, (250-275°F).

This involved adding the polythene granules to the two grades of asphalt cement, and stirring the combination slowly for periods of 5 minutes, 10 minutes and 20 minutes, with the amount of polythene incorporated varying in 2% increments to a maximum of 10%. In all cases, there were indications of incomplete mixing with both grades of asphalt cement and all three lots of polythene. The amount of free (unmixed) polythene present at the end of the mixing period was greatest at shortest mixing time, highest percentage added, and varied proportionally to the molecular weight of the additive. The variation of test results for penetration, softening point, etc., was very large, due to the tendency of the undissolved polythene to float to the surface of the test samples. The test results, while invalid due to the evident lack of homogenicity of the mixtures, did indicate qualitatively, at any rate, that the presence of polythene in an asphalt cement tended to reduce the penetration of the asphalt and increase the softening point. The penetration at 32°F was reduced somewhat, though to a lesser degree, indicating a reduction in the temperature susceptibility of the bitumen.

In an attempt to eliminate the heterogeneity noted, it was then decided to try and dissolve the polythene granules in some solvent and then add the solution to the hot bitumen. Several solvents, such as carbon tetrachloride, nitro-benzene and trichloroethylene were considered unsuitable as the asphalt cement itself is highly soluble in them. Stearic acid and m-xylene were both considered, but were rejected, the former due to the fact that its solubility was quite low.

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M-xylene proved to be a better solvent but was rejected on economic considerations. An extremely good solvent for polythene, paraffin wax, was investigated more thoroughly. An initial mixture of one part by weight of polythene to two parts by weight of paraffin was prepared, and then mixed with both the hard and soft grades of asphalt cement in quantities such that the actual amounts of polythene present in the mixture varied in 2% increments to a maximum of 10% (by weight) as previous. This admixture tended to reduce the penetration, temperature susceptibility and ductility, while increasing the softening point. All the test samples appeared quite homogeneous, were waxy to the touch, and at normal room temperatures showed a considerable elastic rebound upon release of stress. The latter characteristic indicated that the paraffin crystallized into a skeleton structure, giving the bitumen a yield stress and increasing its brittleness (2). The impermanent nature of paraffin wax in asphalt (1) is undesirable also, so work on this phase was abandoned.

Although the melting point of the polythene used was fairly low (232°F), the resultant melt was extremely viscous, and exposure of the hot melt to normal room temperatures caused extremely rapid surface cooling. These characteristics made it impossible to melt the polythene prior to mixing, and then introduce it to the hot asphalt cement. Also, since the polythene had a specific gravity somewhat lower than the asphalt cement, it tended to float

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to the surface of the mixing bowl, increasing the problem of obtaining a homogeneous mixture. With commercial polythene in question then, the approach to the mixing problem from a viewpoint of reproducing field techniques did not seem promising.

A second approach to obtaining a homogeneous mixture was to increase the temperature of mixing to the range used in blending asphalts at the refinery. Modification of the mixer was not possible at the time, but it was possible to increase the heat, and maintain it at close to 400°F.

The mixing technique followed was as outlined previously. The polythene, in the form of granules was added slowly to the hot asphalt cement. At the end of twenty minutes of continual, slow stirring a homogeneous mixture was obtained for Lots 63, and 119. The highest molecular weight polythene (Lot 2461) still did not dissolve completely, and consequently no significant test results have been reported.

In this latter series of experiments, it was decided to reduce possible variables by assessing the rheological properties of one grade of asphalt cement. The soft binder was selected for this purpose. Also, since there was some danger of oxidation of the asphalt during mixing at the elevated temperature chosen, several determinations of penetration were made on the asphalt prior to mixing. These tests indicated no apparent change, leading to the conclusion that oxidation effects were very slight, at least as measured by the penetration test.

Table C - Sheets 1 and 2, presents, in abridged form some of the pertinent results reported herein.

It is immediately apparent that the addition of commercial polythene to asphalt cements of paving grade causes a distinct decrease in normal penetration and penetration at 32°F, with a marked decrease in the ductility. There is a corresponding increase in the softening point.

These relationships are shown graphically on Plate 2, for the latter series of mixtures discussed heretofore.

The curves plotted show that the decrease in penetration, and increase in softening point are proportional to the amount of polythene added to the asphalt. They show also that above about 6% additive the amount of change tends to decrease with increasing additive content. The reason for this change in the rate at which the consistency varied is not apparent. All mixtures, conducted at the high temperature range appeared homogeneous, but some additional tests not noted herein indicate qualitatively, at any rate, that above about 10% additive, some of the polythene refused to enter the solution homogeneously.

By plotting penetration versus temperature, it is possible to obtain some idea of the change in the temperature susceptibility of the asphalt cement with increasing polythene content. Although the plot showing straight lines connecting corresponding points at 32°F and 77°F is not theoretically correct, the actual relationship of penetration to temperature being curvilinear on an

Additive	Asphalt	% Additive	Penetration 100g-5 sec. 77°F	Penetration 200g-60 sec 32°F	Softening Point °F	Mix. Time mins.	Mix. Temp. °F	Ductility cms.	Remarks: NOTE. Percentage Additive expressed as percent by weight of Asphalt Cement.
Polythene	Husky	0	279	65	96	10	250		Mixtures not homogeneous. Polythene
Lot	Pen.	2	273	55	97.5				added directly to hot asphalt cement.
63.	200-	4	212	51	102.5		to		Mechanical Stirring.
	300	6	217	43	106				
		8	183	43	120.5		275		
		10	156	40	124	"			
Polythene	Husky	0	325	68	98	20	250		Mixing time doubled. Mixtures some-
Lot	Pen.	2	300	63	101				what more homogeneous, but still some
63.	200-	4	245	58	105		to		free polythene granules visible,
	300	6	235	56	114				especially at higher additive contents.
		8	219	49	121		275.		
------		10	171	43	131	"			
Polythene	Husky	0	113.5	18.0	107.7	20	250		Mixtures lack homogeniety, with free
Lot	Pen.	2	111.5	16.5	111.2				polythene granules visible. Deviation
63	100-	4	92.6	15.0	120.4		to		of test readings high.
	120	6	95.3	13	121.3				
		8	60.6	-		"	275		
		10	53.5	-					
Polythene	Husky	Mixture of 1 Part Polythene to 2 Parts Paraffin Wax.							Mixture of 1 part Polythene to 2 parts
Lot	Pen.	Poly. Parff.							Paraffin wax by weight mixed at 250°F.
2461.	200-	0 0	325	67	98	20	250	+100	Resultant Mixture added to hot Asphalt
	300.	1 2	317	50	102.0			44.2	Cement at 250-275°F, with mechanical
		2 4	281	43	104.0		to	-	stirring. Specimens quite waxy to touch.
		5 10	234	30	107.6			11.2	Evidence of Elasticity. Strength of
		7 14	186	29	118.2		275	10.7	specimens quite low.
		10 20	92	25	126.3	"		3.0	

NOTE. All control specimens poured and stirred at appropriate mixing temperature for same period of time as specimens with Polythene.

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Additive	Asphalt	% Additive	Penetration 100g-5 sec. 77°F	Penetration 200g-60 sec 32°F	Softening Point °F	Mix. Time mins.	Mix. Temp. °F	Ductility cms.	Remarks
Polythene Lot	Husky Pen.	Mixture of 1 part Polythene to 2 parts Paraffin Wax (by weight) Poly. Parff.							Homogeneous mixture obtained by use of high-speed counter rotating mixer.
2461	100-	0 0	114	19	107.0	10	250	+100	However large amount of air entrapped
	200	2 4	97	18	112.0	"		+ 80	in samples die to this process. Specimens
		4 8	94	17	115.7			54	quite waxy to touch. Some elasticity
		6 12	76	15	118.0		to	39	evident.
		8 16	66	14	124.5			23	
		10 20	58	14	126.3	"	275	20	
*Polythene	Husky	0	274	51	97.0	20	390	+100	Mixtures stirred slowly at 390°F-410°F
LOT	Pen	2	212.5	44	97.0			68.5	for a total of twenty minutes. Polythene
119	200-	4	192.5	39	111.2		to	34.0	added in small increments for first ten
	300	6	132	34	118.6			25.5	minutes. Mixtures appear quite homogen-
		8	115	30	123.6		410	19.5	eous.
-----		10	114	26	124.7	"		18.5	
Polythene	Huskyy	0	280	44	96.0	20	390	+100	As Above:
Lot	Pen.	2	239	35	99.5			-	
63.	200-	4	182	27	105.2		to	64	
	300	6	151	21	110.0			40	
		8	107	18	120.4		410	32	
		10	90	17	121.9	"		24	
Polythene	Husky	0							Unable to obtain significant test
Lot	Pen.	2							results due to evident lack of homo-
2461	200-	4							geniety in test specimens.
	300	6							
		8							
		10							

* This mixture used in preparation of compression and tension specimens for assesment of fundamental properties of compacted aspahlt mixtures.

NOTE. All control specimens poured and stirred at appropriate mixing temperature for same period of time as specimens with Polythene additive.

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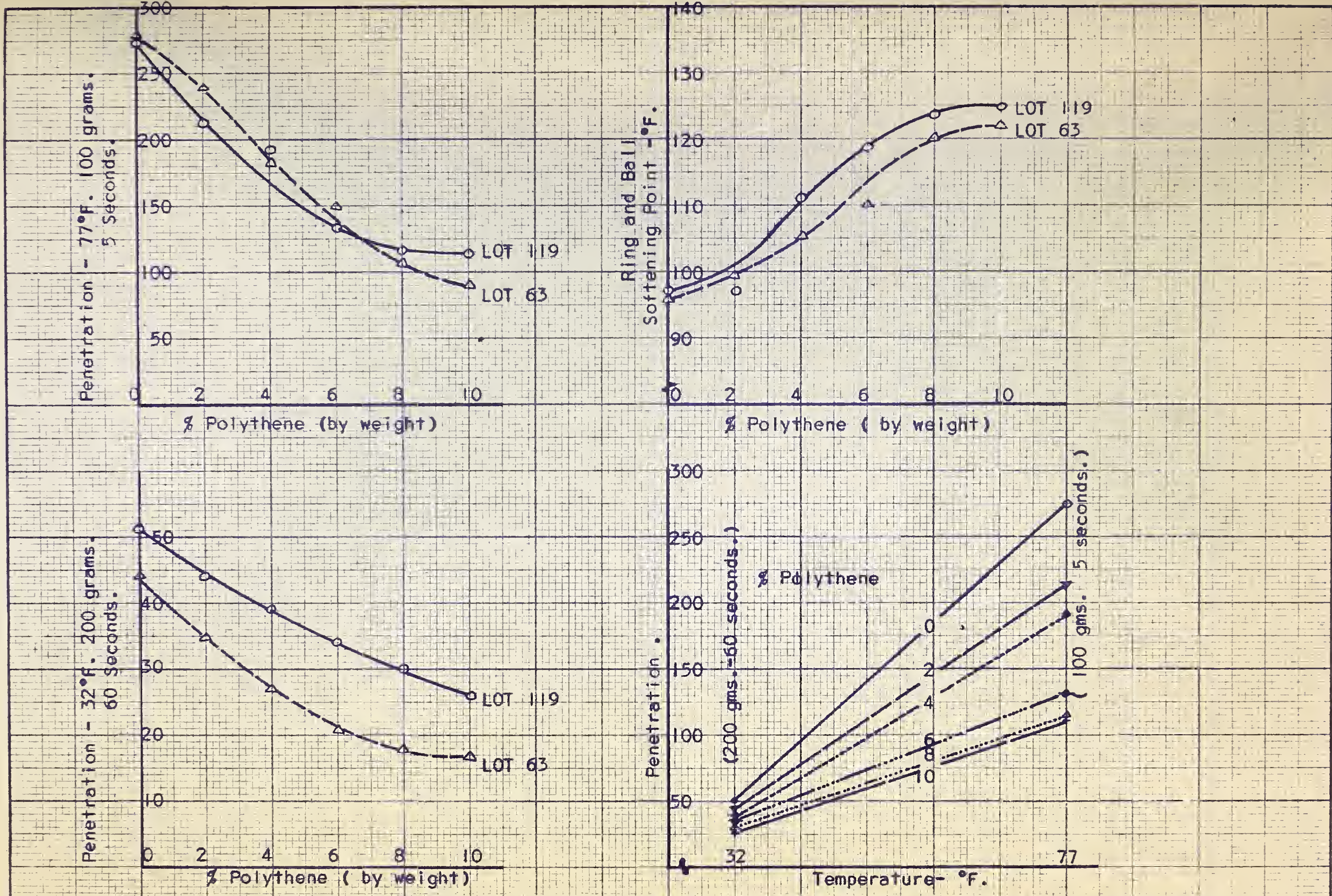

VARIATION IN PENETRATION AND SOFTENING POINT FOR PEN. 200-300 ASPHALT CEMENT WITH POLYTHENE CONTENT.

PLATE 2.

arithmetic plot (15), the relationship does indicate a decrease in temperature susceptibility with increasing polythene content, as measured by the penetration test.

The relationships shown on Plate 2 are by no means to be considered definite or final. The mixing problem still must be investigated much more thoroughly. The actual operation of obtaining a homogeneous mixture by adding the commercial cube-cut granules proved difficult and time-consuming, and with increasing molecular weight of the additive, as noted above, a marked degree of heterogeneity was evident.

In this respect, it is interesting to note that towards the latter stages of this investigation an additional sample of Polythene 119 was obtained. This material differed from the original lot only in form. Whereas the former was in the usual shape of roughly cubical particles about 1/8" on a side, the second lot came in the form of a powdery fluff composed of short, extremely fine filaments, similar to a cotton waste. It is shown on the right hand side of Plate I. This material has been designated Polythene 119 (Waste), as it is an accidental byproduct of the process used in producing the commercial granules. Recent investigations, which are not yet completed, show that homogeneous mixtures can be obtained in about half the mixing time necessary with the cube-cut granules and at substantially lower temperatures (275-300°F). The reduction of penetration, temperature susceptibility and ductility, and increase in softening point are the same as observed with the original granules. Possibly the more

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efficient mixing noted is due to the fact that the "waste" material has an extremely large surface area in relation to its volume as compared to the ordinary granules, and would therefore melt more readily.

As stated previously, the scope of this initial investigation leaves many questions unanswered. A primary one, of course, is what happens to the chemical structure of the asphalt when polythene is added to it? What is the effect on the weathering characteristics of the mixture, and are the changes in rheologic properties permanent? In the last regard, a series of test specimens are being tested for normal penetration over a long period of time. At the time of writing these specimens have been ageing at room temperatures for approximately six weeks. No significant change in penetration has been observed to date, but the time of ageing is extremely short, and the penetration test may not be sufficiently sensitive to minor changes in properties due to thixotropic effects.

The question of the effect of polythene on the oxidation characteristics of paving asphalts has not been investigated to date, except as noted in the second phase of this program.

The change in rheological properties observed is quite similar to the limited data published in corresponding rubber-asphalt research (14,15), although the actual physical mechanism involved may be considerably different.

The results, in general, show that the incorporation of polythene into asphalt cements tends to increase the stiffness of the asphalt, and reduce its temperature susceptibility somewhat. The marked decrease in ductility noted would seem

harmful in view of what has been said previously. However, the same changes in rheological properties are evident when rubber is added to asphalts. (3, 13, 14, 15).

In summation,

(i) When polythene is added to an asphalt cement, it is observed that

(a) The penetration is reduced.

(b) The ductility is reduced markedly.

(c) The softening point is increased.

(d) The temperature "susceptibility" is reduced somewhat.

(ii) When rubber is added to an asphalt cement, it is reported that

(a) The penetration is reduced.

(b) The ductility is reduced.

(c) The softening point is increased.

(d) The temperature "susceptibility" is reduced.

With regard to rubber-asphalt mixtures, present investigations are being directed towards assessing the above noted changes in rheological properties in terms of the actual service performance of the pavement. As one approach, full scale field tests are being performed, and while the results of these tests are still incomplete, there is some indication that the presence of rubber in a paving mixture tends to decrease transverse cracking, and to improve the surface texture qualities of these mixtures by virtue of increased skid resistance. In most cases, the observed benefits are slight, and no final conclusions are possible.

In addition, the recent work of Gregg (15), shows that whatever beneficial effects that may be derived from the incorporation of rubber in paving mixtures depend upon the type of rubber utilized, and upon the degree of dispersion obtained. It was observed that the most beneficial effect, as regards resistance of a compacted specimen to repeated bending, was obtained where the rubber was only partially dispersed in the asphalt cement, and retained enough of its original form to impart a fibrous texture to the binding medium. It should be noted that the latter phenomena has been assessed not only on a laboratory basis, but also in a field installation. However, no data is available on the actual performance of this test strip, in terms of any evident increase in durability, or resistance to transverse cracking.

Apart from providing a fibrous structure to the binding medium, it has been suggested that rubber, in either the powdered form, or in a partially dispersed form, absorbs part of theliquid phase from the asphalt, swelling to several times its original volume. This absorption would in effect increase the asphaltene-liquid phase ratio within unabsorbed asphalt, making the binder harder initially. This would tend to decrease the penetration, increase the softening point, and decrease the ductility. It is hypothesised that increased durability of the paving mixture may result if the absorbed liquid phase (the petrolenes and resins) were slowly given back to the asphalt binder as the pavement aged.

It should be noted that the benefits claimed by the addition of rubber to asphalts are slight, and the data derived to date is too limited to substantiate any positive claims. (3, 14, 15).

At present, it does not seem advisable to make a direct quantitative comparison of the changes noted in the rheological properties of asphalt cements containing polythene, and those containing rubber. This is due mainly to the fact that the published data available on the latter deal with hard asphalt cements in the penetration range of about 60 to 100, while the work embodied in this report is concerned with an extremely soft asphalt cement (pen range 200-300). In addition, very little data is available on the effect of varying concentrations of rubber additives, and there is little agreement to date on what types of rubbers are most beneficial.

The latter arguements apply to polythene-asphalt mixtures as well, and the data derived in this report is limited to only two types of commercial polythenes and a soft, uncracked asphalt cement.

As noted previously, however, the trend of observed changes in rheological properties for both polythene-asphalt mixtures, and rubber asphalt mixtures, are qualitatively the same.

The exact function of the polythene is an asphalt cement is not known to date. It appears that the polythene goes into intimate solution with the asphalt, with the mixing process utilized herein. Whether the polythene molecules combine chemically with the asphaltenes, or remain in the intermicellar fluid (the petrolenes and resins) is not known. Examination of the polythene-asphalt mixtures showed they were quite homogeneous, with no free polythene particles evident. Also, examination of the various compacted test specimens, dealt with in the next chapter, did not reveal the fibrous characteristics that seem to denote a bene-

ficial effect through the use of rubber in asphalts. Possibly, the marked changes in rheological properties noted with the addition of polythene to asphalt cements, may be due to an increase in the asphaltene-liquid phase ratio, which normally gives rise to increased viscosity, and thus a decreased penetration, etc.

Since little correlative data is available, and the exact mechanism by which polythene changes the properties of asphalt cements is not known, it was deemed essential that some basic data be derived on the fundamental characteristics of compacted asphalt paving mixtures, to assess the actual effects of these observed changes in the properties of the binder, in order that a more complete understanding of these effects might be reached.

CHAPTER IV

PRELIMINARY STUDIES OF THE EFFECT OF POLYTHENE-ASPHALT BINDER ON COMPACTED PAVING MIXTURES

The reasons for assessing the effect of polythene-asphalt binders on the properties of compacted mixtures have been given previously. As well as there being little correlative data in the literature on rheological properties of the binder versus mechanical properties of the mixture, the asphalt-polythene mixture might embody whole new ranges of penetration, ductility, etc., and as was shown in corresponding research on rubber-asphalt mixtures, this appears logical. In addition, while the changes in the rheological properties of asphalt when polythene is added to it are quite large, the actual significance of these changes may be of an entirely different magnitude in a paving mixture where the binder exists in the form of extremely thin films of the order 10-20 microns and where the stress conditions may be entirely different from those existing in the emperical consistency tests employed.

Again, with the limited data derived from the first phase of the investigation, it was decided to evaluate the effects of polythene on actual mixtures by using only one grade of asphaltic bitumen and one type of polythene. The soft asphalt (pen 275) was selected as the effect of polythene on its rheological properties was most distinct. Polythene Lot 119 was selected since its properties represented the average of the three lots investigated. Also, it had the better low temperature properties (Table B) of the two lots that could be introduced homogeneously into the asphalt cement.

From inspection of the data contained in Table C and Plate 2, and from some economic considerations it was decided to incorporate the polythene in 2% increments by weight of asphalt cement, up to a maximum of 6%. In order to assure a constant quality of polythene-asphalt binder, each lot was made up in approximately 500 gram batches, each batch being heated to 390-410°F, the required amount of polythene being added slowly during the first ten minutes of stirring, and the stirring being continued for an additional ten minutes. The control binder, without additive, was also heated in 500 gram batches for a period of twenty minutes. Quality was checked by normal penetration tests. Each lot of asphalt binder at 0%, 2%, 4% and 6% polythene additive, by weight, totaled approximately 2400 grams.

The rheologic properties of the binder, prior to mixing with aggregate are those given in Table C and Plate 2 for 200-300 pen. asphalt cement, with Polythene Lot 119 (cube-cut structure) and 20 minutes mixing time at 390-410°F.

In the field of asphalt paving technology, there exist many test methods for gauging the quality of an asphalt paving mixture. Most of these are emperical by nature, and nearly all tend to emphasise the quality of stability (8). As has been noted in Chapter I, the stability, or resistance to displacement, of a bituminous paving mixture, is dependent primarily upon the quality of the mineral aggregate, and the asphaltic bitumen in these test methods plays a lesser part. Since the objective of this part of the investigation was to obtain quantitative data on the fundamental properties

of polythene-asphalt mixtures, it was advisable to select a test method, or methods, that would emphasise the function of the bituminous binder. For this reason, the unconfined compression test was selected as one possible test method. It was felt that with this test method, the fundamental characteristics of the mixtures in question could be obtained. Another test method, in fairly general use, is the Marshall Stability Test (9). This method is actually a semi-confined compression test. It was considered for use in this investigation primarily because it had been used at a similar stage in rubber-asphalt research (14), but was rejected for several reasons. Included in these reasons were the fact that the test is run at a very high rate of strain (2 inches per minute) which would make it impossible to obtain fundamental stress-strain data, without recourse to some complicated stress-strain recording apparatus, or high speed photography. Also, the requirement that eight specimens be made at each asphalt content indicates that the method is not too accurate. In addition, the stress relationships in the semi confined specimen are more complicated than in an unconfined compression test. For this preliminary investigation then, it was felt that as much fundamental data could be derived on the function of the bituminous binder phase by an unconfined compression test.

In considering the use of the unconfined compression test, some consideration was given to the actual stress state in an asphalt specimen undergoing deformation. According to Nijboer (18) the resistance to deformation of an asphalt specimen is

composed of three parts; these are

(i) Frictional resistance which is the resistance of one aggregate particle to movement across another, and of the structural interlock of the compressed mineral aggregate structure.

(ii) Initial Resistance (more commonly called cohesion), which is the binding effect of the asphaltic bitumen, and is a function of the viscosity.

(iii) Viscous Shearing resistance, which is the resistance of the bituminous phase to movement. This latter resistance is a function of the viscosity and a direct function of the rate of deformation.

Since the strength of the unconfined compression specimen is due in part to the inert aggregate, it was decided to supplement the data obtained by such tests with a test method that would give the fundamental stress-strain relationships, when strength was dependent solely on the binder. The pure tension test met the requirements noted.

Reference to the literature reveals little on the subject. Pfieffer, in an early study, compared several test methods, and favored the use of a long rod-like test piece with belled ends (19). He found that tensile strength varied with the rate of strain. In a recent study of reflection cracking of asphalt surfaces overlying Portland Cement concrete bases, Bone, Crump and Roggeveen (20), used "dog bone" specimens subjected to both static loadings and a constant rate of strain of 0.143 inches per minute. Both investigators state

that deviation of results about the mean is considerable.

For the purposes of this investigation it was decided then to run unconfined compression tests, on cylindrical specimens and corresponding pure tension tests on "dog bone" specimens. By these two test methods it would be possible to assess the effect of the polythene-asphalt binder under two different stress states encountered in the field. Unconfined compression would simulate, to some degree, the stress effects caused by wheel loads on the pavement surface, while pure tension might correspond closely to the stress state in an asphalt pavement contracting with a change of temperature.

Most investigators are in agreement that the actual stress state in a bituminous pavement is one of bending and that the critical condition exists when the pavement is subjected to loads causing bending at low temperatures (6,7,15). This seems logical, but the stresses set up in asphalt mixtures under bending are rather complicated, so it was decided to evaluate the mixtures by the two fundamental tests described herein.

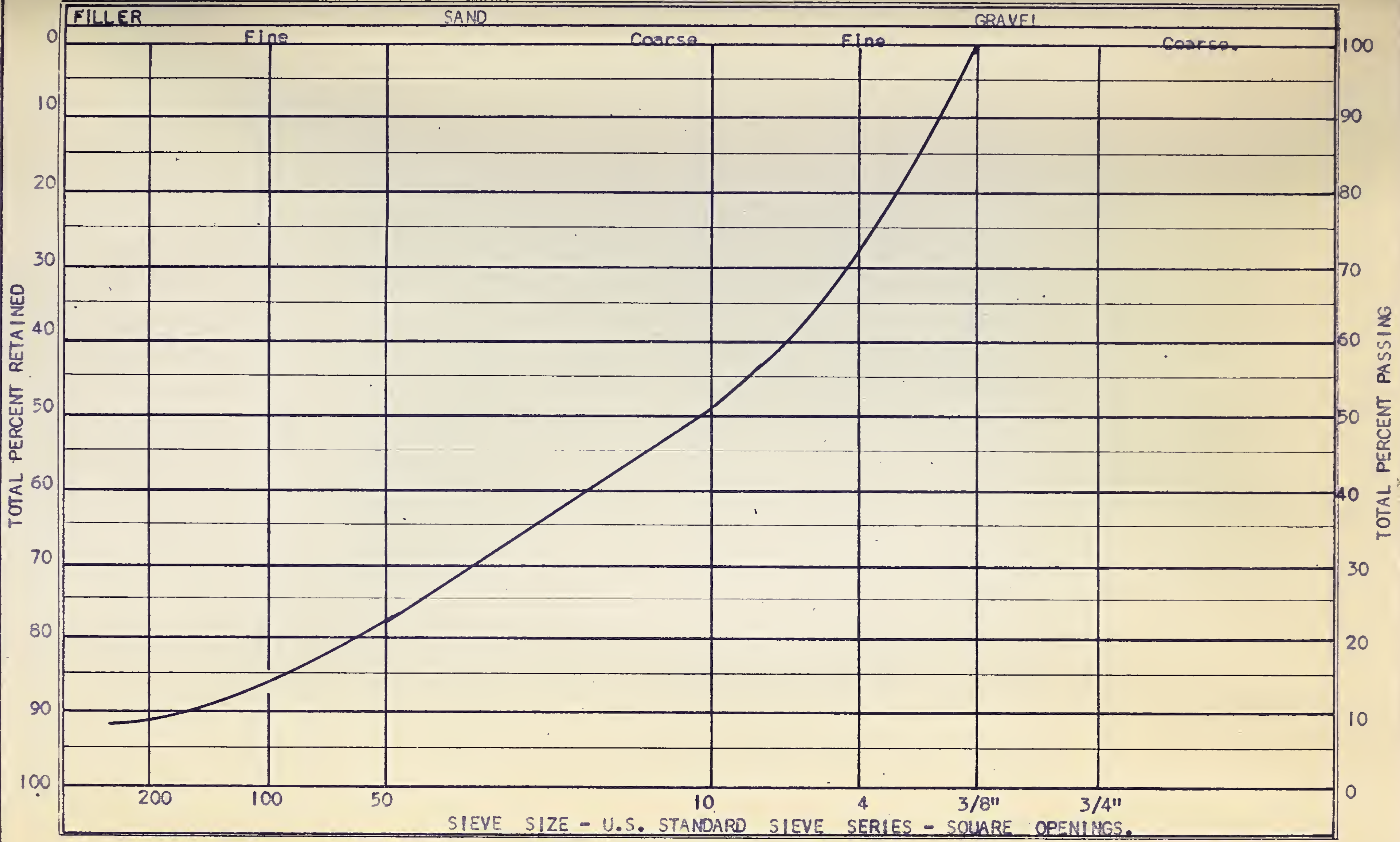
In selecting the mineral aggregate with which the binder would be mixed, it was considered desirable to use as fine a material as possible, in order that uniform test specimens, of manageable size could be produced quickly. Current practice usually limits the least dimension of a compacted test piece to between four and five times the maximum particle size present in the aggregate. In order to duplicate closely a typical asphalt mixture, a maximum particle size of 3/8" was

selected, and the gradation was selected to correspond to a typical surface course gradation employed in high class, hot mix construction.

To reduce test variables due to variation in the mineral aggregate, the gravel selected for use was broken down by dry sieving into six fractions from retained on #4 (U.S.) Sieve to pass #200 sieve. Each fraction except the last, was then decanted and sieved through a mesh series finer than the size in question. Thus six separate sieve analyses were obtained. These analyses were then recombined algebraically by successive approximations to meet the gradation desired. The dry aggregate for each test specimen was then batched separately, in the proportions found from the algebraic computation. Weights were taken to the nearest gram. The gradation of the mixture is shown on Plate III.

Test specimen sizes were set at 2" diameter by four inches long for the cylindrical compression samples. For the "dog bone" tension specimens, dimensions of 6" long with a 4" long center section 1" x 1" square and flared ends 2" wide were chosen. It can be seen that the narrow cross section chosen for the tension specimens, does not meet the limiting criteria, for minimum dimensions mentioned above. However, it was felt that in order to keep the specimens to a manageable size a compromise must be effected.

The asphalt content, which was to be kept constant was selected at 8.0%, on the basis of surface area requirements. The mixing process was that utilized in the Marshall Stability Test and is outlined in Appendix A.



AGGREGATE GRADATION OF TEST MIXTURE

PLATE 3.

Compaction of the specimens was done by direct compression, double plunger compaction being used on the cylindrical test pieces. The method employed is outlined in Appendix A.

It should be noted that the compaction method utilized is quite arbitrary and according to some investigators (21) bears little relationship to actual field conditions. However, the main problem in this investigation was to produce uniform test specimens, so that the major variables could be evaluated on a comparative basis.

Several trials were made initially on methods of compacting the 2" diameter cylindrical specimens. Once a realistic density was obtained the method was standardized and all specimens were fabricated in exactly the same fashion. Briefly, the method involved filling the split mould (Plate 4) to two thirds the depth and rodding the mixture 25 times with a thin bladed spatula $4\frac{1}{2}$" long by $\frac{3}{4}$" wide. The mould was then filled to the top and the rodding repeated. The top plunger was placed on the specimen, pressed in by hand and rotated under pressure to smooth the bearing surface. The mould was then placed on the bed plate of the laboratory Tinius Olsen hydraulic testing machine. Load was applied gradually over a period of one minute to a maximum of 2000 psi, which was held for a further period of one minute. The load was then released at a rate of 10 psi per second. The test specimen was then chilled in a cold water bath for approximately 5 minutes after which it was removed from the mould. The density of the specimen was obtained from its weight in air and the measured volume.

COMPACTION MOULDS USED IN FABRICATION OF COMPRESSION AND TENSION SPECIMENS.

PLATE 4.

To obtain a corresponding density in the tension test specimens, it was necessary to run several trials with different tamping procedures and unit pressures. The method selected involved filling the mould to 2/3 the depth and rodding the lift 50 times, with the thin bladed spatula. The mould was then filled to 1/8" above the top, and the rodding was repeated. The top of the specimen was then levelled by scraping the excess mixture from the top, and setting the compression head on by hand pressure, care being taken that the head was level. The mould with base plate was then placed on the bed of the testing machine and load applied over a period of one minute to a maximum of 2500 psi. This was held for one minute and then released at a rate of 20 psi per second. The specimen and mould were then chilled in the cold water bath for a period of approximately 5 minutes. The specimen was then removed from the mould, weighed, and its volume computed from its weight in air minus its weight in water.

The efficiency of these methods is discussed in the next chapter.

The testing program was established with three major variables in mind. These were-

(i) The effect of the amount of polythene in the asphalt cement.

(ii) The effect of temperature on the properties of the mixtures.

(iii) The effect of age on the properties of the mixtures.

It was decided to test the mixtures at four different temperatures to cover a normal range of service conditions. The temperatures selected were 140°F, 75°F, 36°F and 10°F. It had been proposed to test a series of mixtures at -30°F, but due to some difficulties encountered in securing accurate instrumentation at +10°F, with the equipment used, this was abandoned in favor of the test series at 36°F. The selection of these testing temperatures was somewhat arbitrary. However the test series at 140°F corresponds to possibly the worst condition that could occur, and is utilized in the Marshall Stability Test. The other test series were selected on a basis of convenience.

In order to simulate actual weathering of an asphalt pavement, it was desirable to test the specimens at different ages, in order to assess whether the polythene had any affect on the ageing process. Since it was impossible to subject the test specimens to actual cycles of weathering outdoors, recourse was made to an accelerated ageing process. This process was used, with some differences, in corresponding research on rubber-asphalt mixtures (15). Three separate "ages" were selected. One test series was stored at a constant temperature of 70°F until testing. A second series were placed in a large mechanical convection, constant temperature oven at 140°F for a period of 29 hours, after which they were removed, and placed in the constant temperature room until tested. A third test series were subjected to the same temperature of 140°F for a period of seventy hours after which they were also stored at 70°F until tested.

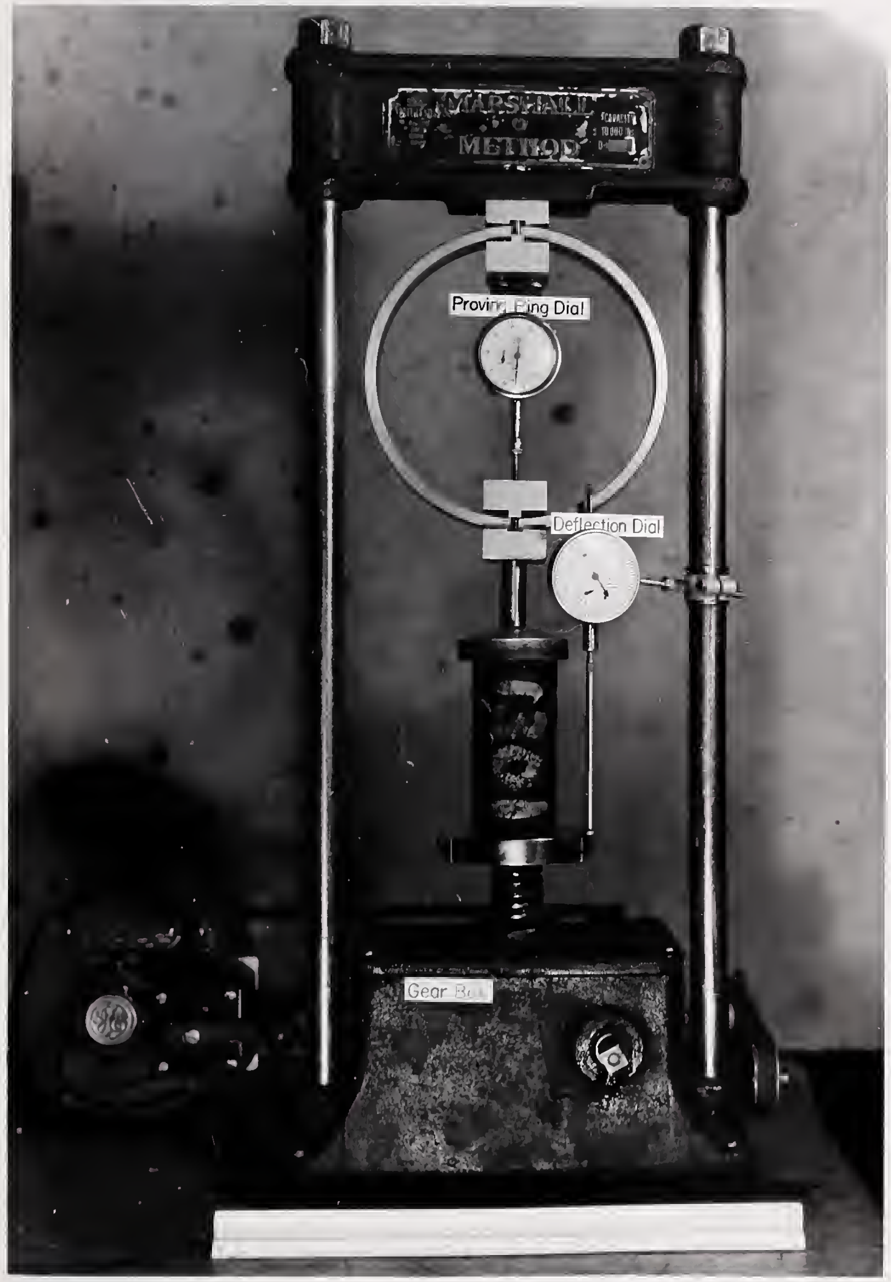
It should be noted that substantially the same accelerated ageing process was used by Gregg. (15). However he used a constant temperature of 212°F. Several trials by the author showed that this temperature was excessive in that the specimens tended to disintegrate due to excessive softening of the binder, The "ageing" temperature was accordingly reduced to 140°F. Gregg makes no mention of excessive softening of the binder at 212°F, but it was noted that the specimens he was working with contained a very hard binder whose normal penetration was about one half that of the specimens containing the maximum amount (6%) of polythene. Whether the accelerated ageing process utilized herein corresponds to the actual weathering process encountered in service is not known, and there is no correlation to date on time in the oven at 140°F to the corresponding time in the service life of the pavement. The process is then quite arbitrary but the combined effect of high temperature and a constant current of air across the specimens must cause some oxidation of the thin binder films, and to this extent corresponds to the actual weathering process in service.

All the specimen series were maintained at the selected testing temperature for a minimum period of 24 hours prior to testing, with the exception of the series at 140°F. These specimens were immersed in a constant temperature bath for a minimum period of two hours, and then tested immediately at room temperature (75°F). Although some surface cooling was inevitable, frequent checks showed that the temperature at the centre of the specimens was 140°F when the bath temperature was maintained at 145°F, and the specimen tested

immediately upon removal from the bath. The other test series were assessed either in the laboratory cold room, or in a room maintained at the temperature desired. In none of the latter cases did the atmospheric temperature vary by more than plus or minus 1°F from the mean.

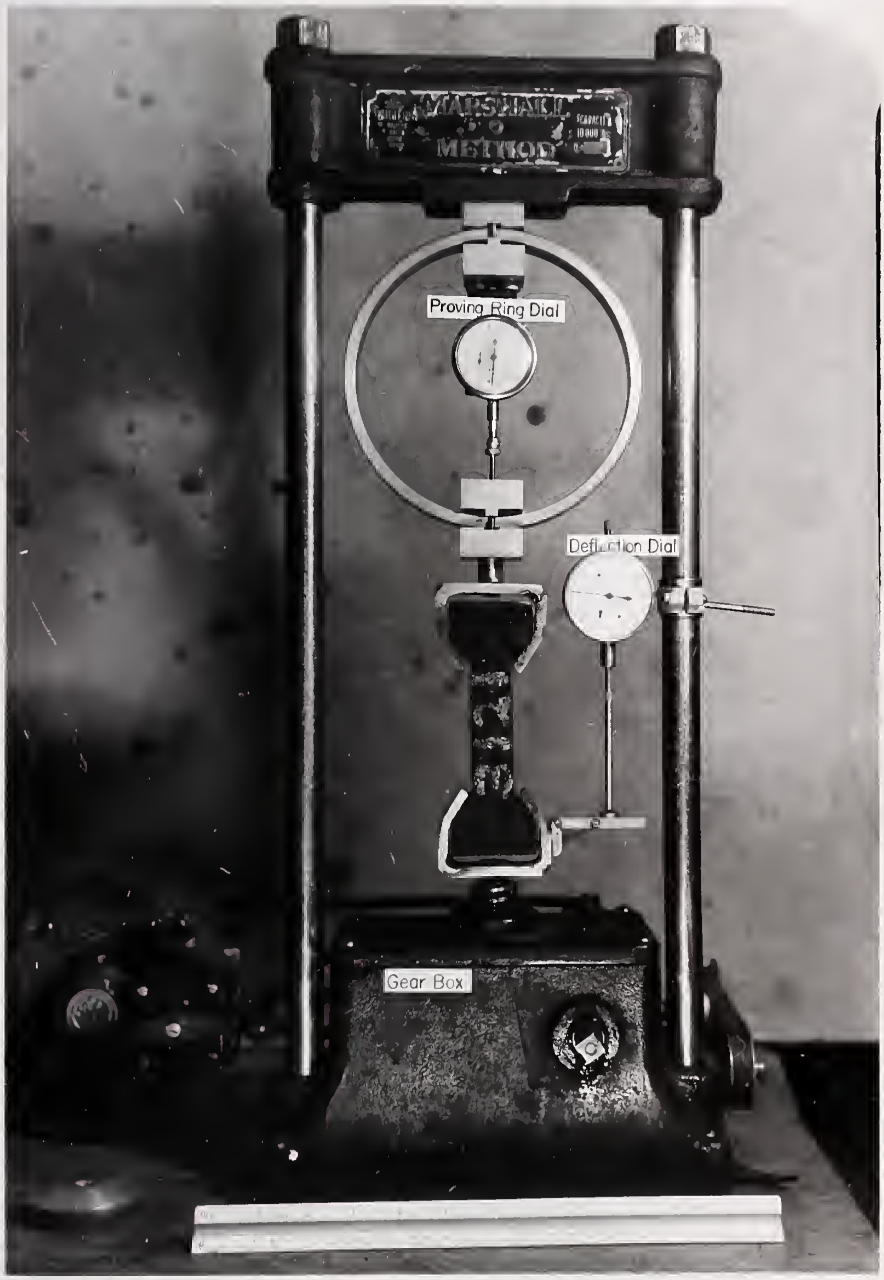
Since the temperature range selected was extremely large, it was necessary that the testing apparatus employed be sufficiently compact and portable that it could be moved without difficulty from one test area to another. Also, it seemed advisable that the apparatus be readily adaptable to both tension and compression tests, in order to eliminate any possible instrumentation errors resulting from the use of two different test apparatuses. Accordingly, a standard Marshall Test Method machine was modified to meet the required conditions. Essentially this apparatus consists of a vertical worm gear shaft which is actuated by an electric motor through a gear box. The top of the shaft forms the bed plate, and the load sustained by a specimen is measured by the elastic deformation of a proving ring which is attached rigidly to the top of the immovable standards on the machine. The machine, as modified for the purposes of this investigation is shown on Plates 5 and 6.

Since the rate of strain in the Marshall Test (vertical movement of the bed plate) is exceedingly high (2"/minute) it was necessary to modify the apparatus to obtain a rate of strain that would allow a single operator to take all readings accurately. The rate of strain selected was 0.08"/minute. The selection of this value was somewhat



CONVERTED MARSHALL TEST APPARATUS WITH
COMPRESSION SPECIMEN IN PLACE.

PLATE 5.



CONVERTED MARSHALL TEST APPARATUS WITH
TENSION SPECIMEN IN PLACE.

arbitrary, but the literature contains nothing definite. It is somewhat below that utilized by Bone et al, (20) and above the minimum utilized by Pfeiffer (19).

The testing technique is outlined in Appendix A. Essentially, the specimen was deformed at a constant rate, and the deflection of the proving ring was recorded at equal increments (0.01") of strain until the deflection of the proving ring began to decrease, indicating that the ultimate strength of the specimen had been exceeded. For this investigation, several proving rings were used, ranging from 25 pounds ultimate capacity to 10,000 pounds. All were callibrated prior to commencement of the tests.

Despite the care taken in combining the dry aggregate fractions, and in mixing and compacting the test specimens, appreciable deviation of the results from the mean would normally be expected due to random distribution of the particles in the test piece. Thus, several "identical" specimens would be made normally to assess any one combination of test variables. Due to the extremely large number of specimens required in this investigation, only two "identical" specimens were made for each condition. The significance of this is discussed in the next chapter.

The program was then laid out so that the effects of three different amounts of polythene additive (2%, 4% and 6%, by weight of asphaltic bitumen), as compared to a control mixture with no additive, would be assessed in unconfined compression and pure tension tests, at each of three ages, and at each of four test temperatures, all

tests to be run in duplicate.

Since this amounted to 192 specimens (96 compression and 96 tension) a convenient coding system was set up in order that a specimen could be identified immediately. Since the individual tests are designated by these code numbers, the system merits explanation.

Each specimen is identified by four code numbers. The first number designates age, the second test temperature, the third the percentage polythene in the binder, and the fourth designates the number in the series. Thus:-

	1 - No accelerated ageing.
Age-	2 - 29 hours at 140°F accelerated ageing.
	3 - 70 hours at 140°F accelerated ageing
Test Temperature-	1 - 75°F. 2 - 10°F. 3 - 36°F. 4 - 140°F.
% Polythene-	0 - 0% polythene by weight of bitumen 2 - 2% " " " " " 4 - 4% " " " " " 6 - 6% " " " " "
Series Number-	1 - Original specimen 2 - Duplicate specimen.

Thus specimen #3241 could be identified as having been "aged" for 70 hours at 140°F, tested at 10°F, with 4% (by weight of asphalt) polythene, and was the original specimen in the series. No differentiation was made between tension and compression specimens since the distinction is obvious.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

The complete group of 192 test specimens was mixed and compacted, and all weights and measurements taken before commencement of the artificial ageing process. Thus all specimens, tension and compression, were aged at the same time under identical temperature conditions, only the duration of the process differing.

In obtaining the fundamental stress-strain data at any one temperature, the complete group of compression specimens were tested, and the apparatus then changed to test the corresponding tension specimens immediately afterward.

CHAPTER V

DISCUSSION OF RESULTS OBTAINED ON THE PRELIMINARY TESTING OF POLYTHENE-ASPHALT MIXTURES

In analyzing the results of this program of investigation, it is first necessary to appraise the fabrication techniques used in making the test specimens. As pointed out in the previous chapter the actual methods involved only approximate field compaction conditions, and that all that could be aimed for was a uniformity of specimens as reflected by the unit weight. Since the mixing and compaction procedures (Appendix A) were not refined enough to produce specimens of exactly equal dimensions, each test piece was measured and weighed, and the unit weight computed. The difference in the dimensions of the specimens was not excessive, so the criterion of uniformity was the unit weight, in pounds per cubic foot. The values found are shown in Table D (Sheets 1 to 4). The frequency curves of Plate 7 show the distribution graphically. The deviation of the cylindrical compression specimens is somewhat larger than that of the tension specimens and of somewhat more normal distribution. The mean unit weight of all the compression specimens was 139.9 pounds per cubic foot, while the mean unit weight of all the tension specimens was somewhat higher - 140.6 pounds per cubic foot. This variation amounts to less than one half of one percent and in comparison to the deviation of the strength results obtained, may be neglected. The combined distribution curve is shown also, and it can be shown from it that 99.4% of all the measured values are within 2.9% of the mean value.

TABLE ~~D~~ - Specimen Fabrication Data
2"Ø Cylindrical Specimens

Number	Av. Length	Weight Gms	Volume cc's	G_b	Unit Wt. PCF	Average Density PCF
1101	4.05 ins.	473.3	248.49	2.270	141.65	
1102	4.00	461.1	205.92	2.239	139.71	
1201	4.20	482.3	216.22	2.231	139.21	
1202	4.20	482.9	216.22	2.233	139.34	
1301	4.15	477.0	213.64	2.233	139.34	
1302	4.15	476.0	213.64	2.228	139.03	
1401	4.15	486.8	213.64	2.278	142.15	
1402	4.05	472.7	208.49	2.267	141.46	140.24
2101	4.10	461.5	211.07	2.186	136.41	
2102	4.20	486.2	216.22	2.249	140.34	
2201	4.12	471.5	212.10	2.223	138.72	
2202	4.15	482.2	213.64	2.257	140.84	
2301	4.20	480.6	216.22	2.222	138.65	
2302	4.15	481.5	213.64	2.254	140.65	
2401	4.14	469.7	213.13	2.204	137.53	
2402	4.05	470.4	208.49	2.256	140.77	139.24
3101	4.02	476.3	206.95	2.302	143.65	
3102	4.10	474.6	211.07	2.249	140.34	
3201	4.12	477.9	212.10	2.253	140.73	
3202	4.15	477.7	213.64	2.236	139.53	
3301	4.12	477.9	212.10	2.253	140.59	
3302	4.01	464.0	206.43	2.248	140.27	
3401	4.15	482.7	213.64	2.259	140.96	
3402	4.20	474.4	216.22	2.194	136.91	140.37
1121	4.09	469.0	210.55	2.228	139.03	
1122	4.12	470.6	212.10	2.219	138.47	
1221	4.13	474.7	212.61	2.233	139.40	
1222	4.04	468.63	207.98	2.253	140.59	
1321	4.13	471.66	212.61	2.218	138.40	
1322	3.95	448.62	203.35	2.206	137.65	
1421	4.03	458.20	207.46	2.209	137.84	
1422	3.83	431.05	197.17	2.186	136.41	138.47
2121	4.15	472.15	213.64	2.210	137.90	
2122	4.16	472.62	214.16	2.207	137.72	
2221	4.03	468.84	207.46	2.260	141.02	
2222	4.15	484.32	213.64	2.267	141.46	
2321	4.10	464.10	211.07	2.199	137.22	
2322	4.16	481.26	214.16	2.247	140.21	
2421	4.19	494.06	215.70	2.290	142.90	
2422	4.13	476.16	212.61	2.240	139.78	139.78
3121	4.16	477.0	214.16	2.227	138.96	
3122	4.24	493.71	218.27	2.262	141.15	
3221	4.16	486.0	214.16	2.269	141.59	
3222	4.12	480.23	212.10	2.264	141.27	
3321	4.20	486.0	216.22	2.248	140.28	
3322	4.17	485.5	214.67	2.262	141.15	
3421	4.20	478.98	216.22	2.307	140.84	
3422	4.13	479.00	212.61	2.253	140.59	140.73

TABLE -D- Specimen Fabrication Data
2" Ø Cylindrical Specimens

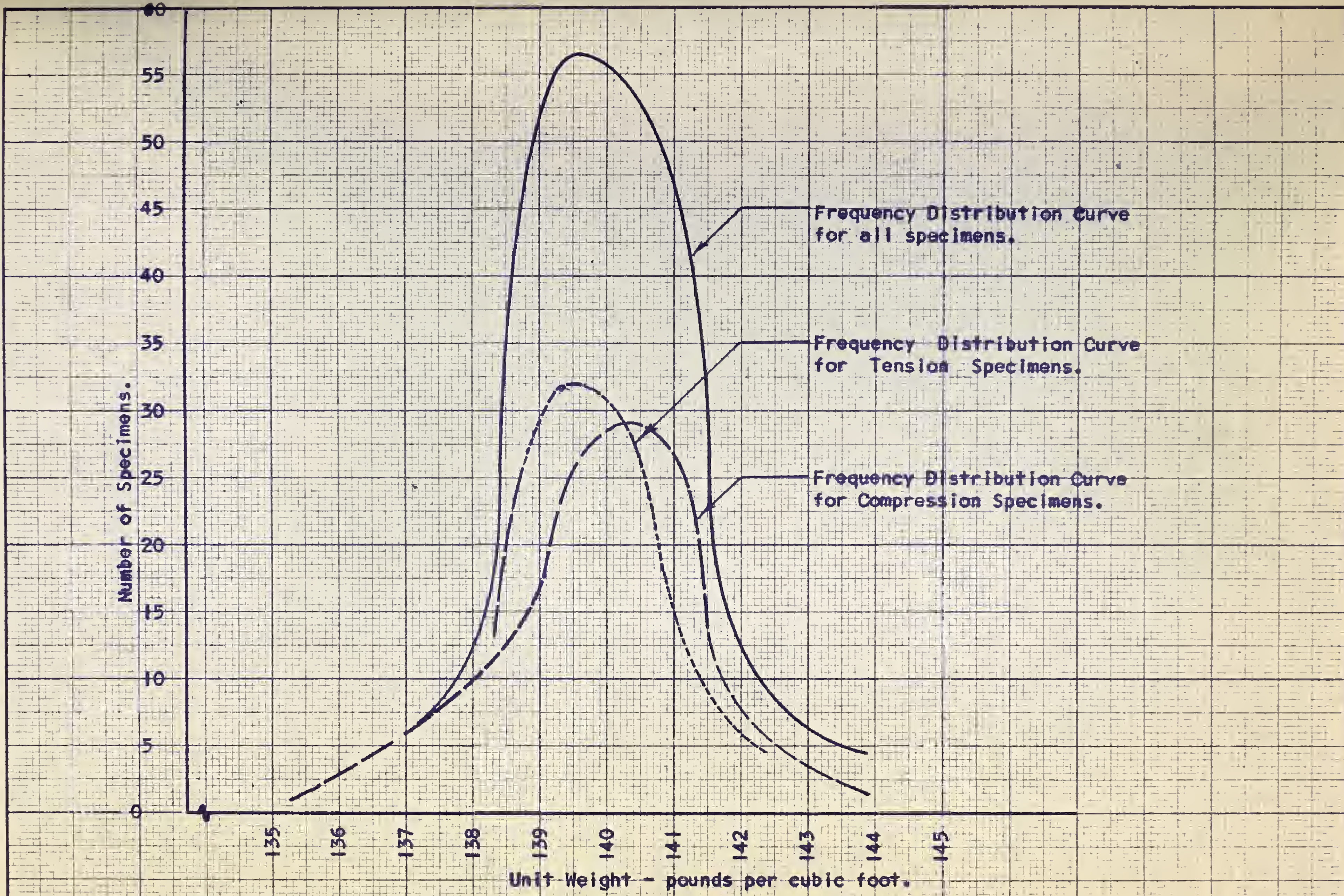
Specimen Number	Av. Length	Weight Ø Grams	Volume cc's	G_b	Unit Wt. PCF	Average Density
1141	4.12 ins	480.30	213.00	2.255	140.71	
1142	4.16	488.90	214.16	2.283	142.46	
1241	4.17	481.23	214.67	2.242	139.90	
1242	4.21	487.20	216.73	2.294	143.15	
1341	4.13	475.50	212.61	2.236	139.53	
1342	4.10	475.28	211.07	2.252	140.53	
1441	4.12	475.09	213.00	2.230	139.15	
1442	4.15	481.20	213.64	2.252	149.53	140.74
2141	4.18	489.20	215.19	2.273	141.83	
2142	4.20	487.00	216.22	2.252	140.53	
2241	4.21	486.86	216.73	2.246	140.15	
2242	4.24	488.70	218.28	2.239	139.71	
2341	4.15	481.48	213.64	2.254	140.65	
2342	4.22	490.83	217.25	2.259	140.96	
2441	4.20	487.40	216.22	2.254	140.65	
2442	4.17	485.33	214.67	2.261	141.09	140.70
3141	4.12	474.52	213.00	2.228	139.03	
3142	4.24	489.20	218.28	2.241	139.84	
3241	4.11	476.40	211.58	2.252	140.53	
3242	4.17	486.31	214.67	2.265	141.34	
3341	4.26	495.48	219.30	2.259	140.96	
3342	4.23	488.85	217.76	2.245	140.09	
3441	4.26	490.34	219.30	2.236	139.53	
3442	4.30	502.60	221.36	2.271	141.71	140.38
1161	4.18	467.3	215.18	2.171	135.47	
1162	4.06	461.0	209.01	2.206	137.65	
1261	4.08	470.7	210.04	2.241	139.83	
1262	4.04	465.7	207.98	2.239	139.71	
1361	4.22	481.3	217.25	2.215	138.22	
1362	4.04	456.2	207.98	2.193	136.84	
1461	4.24	487.4	218.27	2.233	139.34	
1462	4.14	475.3	213.13	2.230	139.15	138.27
2161	4.18	475.2	215.19	2.208	137.78	
2162	4.13	470.8	212.61	2.214	138.15	
2261	4.29	498.0	220.85	2.255	140.71	
2262	4.27	495.8	219.82	2.255	140.71	
2361	4.22	485.9	217.25	2.237	139.59	
2362	4.11	481.1	211.58	2.274	141.90	
2461	4.21	490.4	216.73	2.263	141.21	
2462	4.19	483.2	215.70	2.240	139.78	139.98
3161	4.20	483.3	216.22	2.235	139.46	
3162	4.14	476.8	213.13	2.237	139.59	
3261	4.18	481.6	215.19	2.238	139.65	
3262	4.26	488.8	219.30	2.229	139.23	
3361	4.21	487.2	216.73	2.248	140.28	
3362	4.13	471.8	212.61	2.219	138.46	
3461	4.16	481.5	214.16	2.248	140.27	
3462	4.15	479.29	213.64	2.243	139.96	139.61

TABLE ~~-D-~~ Specimen Fabrication Data
6" Tension Specimens

Number	Wt.Air	Wt.Water	Vol.	G_b	Unit Wt.	Depth Av.	Width Av.	Area Av.	Av. Unit Weight
	(gms)	(gms)	(cc.)		#/ft.^{3}	ins.	ins.	ins.^{2}	#/ft.^{3}
1101	309.84	170.82	139.02	2.229	139.09	1.03	1.00	1.03	
1102	299.51	165.33	134.18	2.232	139.28	1.00	1.00	1.00	
1201	315.12	181.90	138.59	2.274	141.89	0.89	1.00	0.89	
1202	320.00	179.99	140.01	2.285	142.10	1.03	1.00	1.03	
1301	317.51	176.53	140.98	2.252	140.52	1.02	1.00	1.02	
1302	295.62	162.84	132.80	2.223	138.72	-	-	-	
1401	302.57	167.94	134.63	2.247	140.21	1.01	0.99	1.00	
1402	313.47	172.44	141.03	2.223	138.71	0.98	1.00	0.98	140.07
2101	308.31	171.22	137.09	2.249	140.33	0.97	1.00	0.97	
2102	309.51	171.42	138.09	2.241	139.84	1.03	1.00	1.03	
2201	310.60	172.35	138.25	2.247	140.21	1.03	1.00	1.03	
2202	313.37	173.61	139.76	2.242	139.90	0.99	1.00	0.99	
2301	299.67	164.76	134.91	2.221	138.59	1001	1.00	1.01	
2302	311.87	172.21	139.66	2.233	139.34	0.98	1.03	1.01	
2401	307.21	170.86	136.40	2.252	140.53	1.02	1.00	1.02	
2402	313.33	173.63	139.70	2.292	143.21	0.98	1.06	1.04	140.24
3101	306.74	169.54	137.20	2.236	139.53	1.01	1.00	1.01	
3102	310.70	171.02	139.68	2.224	138.78	0.98	1.06	1.04	
3201	304.32	168.30	136.02	2.237	139.59	1.02	1.00	1.02	
3202	309.52	170.65	138.87	2.229	139.09	0.96	1.04	1.00	
3301	311.02	171.20	139.82	2.224	138.78	1.03	0.98	1.01	
3302	310.62	171.81	139.81	2.222	138.65	1.03	0.98	1.01	
3401	325.01	181.11	143.90	2.258	140.89	1.00	1.05	1.05	
3402	312.57	172.21	140.36	2.227	138.96	0.98	1.04	1.02	138.96
1121	304.38	168.61	133.77	2.275	141.96	1.02	1.00	1.02	
1122	313.91	172.76	141.15	2.224	138.78	0.99	1.08	1.07	
1221	309.93	171.42	138.51	2.238	139.65	1.03	1.00	1.03	
1222	302.50	166.33	136.17	2.221	138.59	0.965	1.07	1.03	
1331	314.93	176.23	138.70	2.271	141.71	1.02	1.00	1.02	
1322	309.91	171.25	138.66	2.235	139.46	0.97	1.06	1.03	
1421	315.36	174.63	140.73	2.241	139.84	1.04	1.00	1.04	
1422	305.14	168.49	136.65	2.233	139.34	0.94	1.07	1.01	139.92
2121	303.22	166.84	136.38	2.223	138.72	1.02	0.98	1.00	
2122	311.26	170.93	140.33	2.218	138.40	0097	1.10	1.03	
2221	306.43	170.27	136.16	2.250	140.40	1.02	1.00	1.02	
2222	299.91	165.58	134.33	2.233	139.34	0.94	1.07	1.00	
2321	310.93	172.53	128.40	2.247	140.21	1.03	0.98	1.01	
2322	303.21	167.04	136.17	2.227	138.96	0.94	1.07	1.00	
2421	298.83	165.00	133.83	2.233	139.34	1.00	1.00	1.00	
2422	311.02	173.93	137.09	2.269	141.59	0.94	1.07	1.01	139.62
3121	316.13	174.92	141.21	2.239	139.71	1.04	1.00	1.04	
3122	309.42	170.92	138.50	2.234	139.40	0.96	1.12	1.08	
3221	311.83	172.37	139.46	2.236	139.53	1.04	1.00	1.04	
3222	314.84	174.21	140.63	2.239	139.71	0.97	1.06	1.03	
3321	310.61	172.22	138.39	2.244	140.03	1.02	1.00	1.02	
3322	316.34	174.68	141.66	2.233	139.34	0.97	1.07	1.04	
3421	303.86	167.42	136.44	2.227	138.96	1.03	0.98	1.01	
3422	316.02	173.64	142.38	2.220	138.53	0.99	1.10	1.09	139.40

TABLE D -- Specimen Fabrication Data
6" Tension Specimens

Specimen Number	Wt. in Air	Weight in Water	Volume cc's	G_b	Unit Weight	Depth Av.	Width Av.	Area sq.ins.	Tension Av. Unit Wt.
	gms.	gms.			$\#/ft.^3$	ins.	ins.		$\#/ft.^3$
1141	293.41	163.38	143.23	2.256	140.77	0.99	1.00	0.99	
1142	307.90	171.97	150.05	2.265	141.33	0.94	1.06	1.00	
1241	300.02	167.14	146.47	2.257	140.84	1.00	1.00	1.00	
1242	299.13	166.22	143.48	2.251	140.46	1.00	1.00	1.00	
1341	300.00	168.18	144.93	2.275	141.96	0.98	1.00	0.98	
1342	300.21	166.72	144.80	2.249	140.34	1.00	1.00	1.00	
1441	304.41	169.91	147.72	2.263	141.21	1.02	1.00	1.02	
1442	297.73	166.52	144.89	2.269	141.58	0.99	1.00	0.99	141.02
2141	298.02	167.42	148.99	2.282	142.40	0.99	1.00	0.99	
2142	296.13	164.94	131.19	2.257	140.84	0.97	1.00	0.97	
2241	305.04	169.31	135.73	2.247	140.21	1.01	1.00	1.01	
2242	297.90	166.33	130.57	2.282	142.40	0.96	1.00	0.96	
2341	303.31	167.56	135.75	2.234	139.40	1.00	1.00	1.00	
2342	302.75	167.84	134.91	2.244	140.03	1.01	1.00	1.01	
2441	298.63	165.20	133.43	2.238	139.65	0.99	1.00	0.99	
2442	302.35	170.42	136.93	2.245	140.09	1.01	1.00	1.01	140.63
3141	318.37	178.12	140.25	2.270	141.65	1.03	1.00	1.03	
3142	306.13	170.17	135.96	2.252	140.52	1.01	1.00	1.01	
3241	301.05	167.63	133.42	2.256	140.77	0.99	1.00	0.99	
3242	305.75	169.77	135.98	2.248	140.28	1.01	1.00	1.01	
3341	300.76	166.61	134.15	2.242	139.90	0.99	1.00	0.99	
3342	299.41	165.63	133.78	2.238	139.65	0.99	1.00	0.99	
3441	301.50	166.70	134.80	2.237	139.59	1.01	1.00	1.01	
3442	302.72	167.52	135.20	2.239	139.71	1.00	1.00	1.00	140.26
1161	316.74	176.09	139.65	2.268	141.52	1.05	1.00	1.05	
1162	321.64	177.46	144.18	2.231	139.21	1.07	1.00	1.07	
1261	311.61	172.17	139.44	2.235	139.46	1.05	1.00	1.05	
1262	315.13	174.11	141.02	2.235	139.46	1.06	1.00	1.06	
1361	304.48	168.93	135.55	2.246	140.15	1.00	1.00	1.00	
1362	312.23	172.72	139.51	2.238	139.68	1.05	1.00	1.05	
1461	301.50	165.71	135.79	2.220	138.53	1.01	1.00	1.01	
1462	321.56	178.12	143.44	2.242	139.90	1.07	1.00	1.07	139.74
2161	319.51	177.09	142.42	2.243	139.96	1.06	1.00	1.06	
2162	318.02	176.73	141.29	2.251	140.46	1.07	1.00	1.07	
2261	312.71	173.86	138.85	2.252	140.52	1.04	1.00	1.04	
2262	316.92	174.78	141.14	2.245	140.09	1.06	1.00	1.06	
2361	308.91	170.98	137.93	2.240	139.78	1.03	1.00	1.03	
2362	309.97	171.52	137.45	2.255	140.71	1.04	1.00	1.04	
2461	303.42	167.61	135.81	2.234	139.40	1.02	1.00	1.02	
2462	308.41	169.58	138.83	2.221	138.59	1.03	1.00	1.03	139.93
3161	303.51	167.20	136.31	2.227	138.96	1.02	1.00	1.02	
3162	297.52	163.22	124.30	2.215	138.22	1.01	1.00	1.01	
3261	315.32	174.24	141.08	2.235	139.46	1.05	1.00	1.05	
3262	298.55	164.42	134.13	2.226	138.90	1.02	1.00	1.02	
3361	296.68	163.83	132.85	2.233	139.34	1.00	1.00	1.00	
3362	305.32	168.24	137.08	2.227	138.96	1.03	1.00	1.03	
3461	304.83	169.21	135.62	2.248	140.28	1.03	1.00	1.03	
3462	327.92	181.72	146.20	2.243	139.96	1.09	1.00	1.09	139.26



FREQUENCY DISTRIBUTION CURVES OF UNIT WEIGHT FOR COMPACTED SPECIMENS.

PLATE 7.

It had been expected that deviations of the observed stress strain relationships could be explained on the basis of differences in unit weight. However, this has not proved possible.

The average unit weight of all the test specimens was 140.2 pounds per cubic foot. For the materials used, this would give rise to an average void content of 10.9%, which is approximately twice what is normally specified as a maximum for heavy duty, hot mix, asphaltic concrete pavements.

The complete stress-strain data derived in this part of the program is contained in Appendix B, sheets 1 to 84. It should be noted that under the test conditions selected, it proved impossible to test the tension specimen group at 140°F, all specimens tending to fall apart under their own weight.

The stress strain curves obtained from this data are shown on Plates 28 to 48 of Appendix B. Before discussing the data contained in Appendix B, the following steps should be noted.

All specimens were tested to failure at a constant rate of deformation of 0.08 inches per minute. The test was continued beyond the peak (or ultimate) load, as indicated by the maximum reading of the proving ring deflection dial, in order to obtain information of the deformability of the specimen after failure, as explained later. The actual deformation of the specimen (elongation or compression) was calculated as the total deformation recorded by the deformation dial on the test apparatus (Plates 5 & 6) less the proving ring deflection. The unit strain was then calculated as the actual deformation divided by the actual length of the specimen, for the cylindrical compression specimens. For the tension specimens, the initial

gauge length was selected as the distance between the flared ends of the specimens, (4"). Though this latter point was selected rather arbitrarily, it appears sound enough for comparative purposes. Also, in 82 out of the 83 tension specimens, that were tested to failure, fracture occurred across the narrowed centre section, there being no evident distress on the portion of the specimens held by the tension jaws. Typical fractures are shown on Plate 27. All compression specimens exhibited a characteristic barrel-shape upon loading to failure".

Unit stress was calculated as the total stress found from the proving ring calibration charts divided by the original cross-sectional area of the test specimen. No allowance was made for increase or decrease in cross sectional area due to shortening or elongation of the test pieces, as the unit strains encountered were quite small, and the difference in stress values was calculated to be less than 2 or 3 percent, in all cases.

Inspection of the stress-strain curves indicated a marked deviation of supposedly "identical" test specimens. However, with only two specimens for each test condition, it proved impossible to eliminate any results and analyze the data on a selective basis. Hence all the stress-strain curves were analyzed, and a mean of the results taken.

In performing this analysis, it was attempted to evaluate seven separate factors from each curve. These were

(i) The yield point stress.
(ii) The % strain at the yield point.
(iii) The ultimate stress.
(iv) The % strain at the ultimate stress.
(v) The Modulus of Elasticity.
(vi) The Modulus of Deformability.
(vii) A Modulus of Toughness.

Since most of the above factors were selected on an arbitrary basis, as they are not well defined in bituminous mixtures, they are explained herein.

The yield point stress and % strain were taken at the point on the stress-strain curve where the curve began to flatten out, or, as was more often the case, where the curve stopped sloping concavely upward and started to slope concave downward. This yield point, according to Vokac (22), represents the stress below which complete elastic recovery will take place in time, the only residual deformation being due to slight reorientation of the surface particles. Whether this applies rigorously in this case where the modulus of elasticity is so poorly defined, is doubtful.

The ultimate stress and % strain were taken at the peak (or maximum point) of the stress-strain curve.

The modulus of elasticity is ordinarily defined as the slope of the straight line portion of the stress strain curve up to the yield point. However, as most of the curves were concave upward within this range it was necessary to select some arbitrary criterion and evaluate all the test curves in this manner. Inspection of the curves led to a definition of the modulus of elasticity as the slope of the straight line joining points on the curve at 0.25% and 1.00% strain. The "modulus of elasticity" as reported herein is thus only a secant to the curve, and is only used as a basis of comparison.

The Modulus of deformability was taken as the negative slope of the straight line portion of the stress strain curve beyond the peak or ultimate strength. In nearly all cases,

where the stress strain curve had been carried beyond the ultimate strength, the straight line portion of the curve was fairly well defined. Vocak considers that this modulus represents the type of flow to be encountered when the pavement is loaded beyond the failure point.

In an attempt to evaluate the mixtures on the basis of their ability to absorb energy, i.e. resistance to impact loads, a modulus of toughness was obtained from the curves. Since the toughness in engineering materials is sometimes defined as the energy absorbed by the material when tested to failure (23), a modulus of toughness could be taken as the area under the stress strain curve up to the ultimate stress, expressed in inch-pounds per cubic inch. Accordingly, the area under each stress strain curve, up to the peak stress, was obtained. This area, multiplied by the scale is recorded as a modulus of toughness of the specimen.

The above noted values are listed on Table E, (sheets 1 to 4), for both the compression and tension specimens. Plate 8 shows a typical stress strain curve and the various characteristics of the curve, as defined herein.

Inspection of the data contained in Table E indicates that the deviation of values is quite large. Hence it is apparent that only trends may be obtained from this data. In each case, the mean of the values obtained from the two "identical" specimens has been used. These mean values have been plotted against % Polythene, with accelerated ageing factor as a third variable for each of the test temperatures, and for both the tension and compression specimens. These relationships are shown on Plates 9 to 15 inclusive.

TABLE -E- 1
Analysis of Stress-Strain Curves For
2" Diam Compression Specimens

E_m - Modulus of Elasticity
E_d - Modulus of Deformation
M_t - Modulus of Toughness

Number	Yield Stress psi.	% Strain	E_m psi	Ultimate Stress psi.	@.U.S. %Strain	E_d. psi.	% Poly.	Mt. in"/in³	Age	Temp.
1101	62.5	1.45	471	78.0	2.10	963	0	3.18	1	75°F
1102	47.0	1.10	434	77.5	2.10	675	0	3.78		
1121	61.0	1.30	800	75.5	2.00	-	2	3.73		
1122	60.0	1.35	637	71.0	2.20	-	2	3.73		
1141	92.5	1.20	1295	107.5	1.80	897	4	3.93		
1142	80.0	1.42	1650	93.0	1.90	804	4	4.20		
1161	88.0	1.60	1342	91.0	1.80	1125	6	3.71		
1162	88.0	1.65	1397	93.0	1.82	817	6	3.24		
2101	63.0	1.32	944	73.5	2.05	585	0	3.00	2	75
2102	53.0	1.44	1145	61.5	2.06	573		3.69		
2121	61.0	1.23	1254	80.5	2.20	700	2	3.92		
2122	60.5	1.15	1282	82.0	2.10	720		4.10		
2141	92.5	1.30	1485	107.0	1.85	849	4	5.01		
2142	80.0	1.35	1813	92.5	2.00	595		4.81		
2161	82.0	1.40	1563	95.5	2.00	597	6	4.59		
2162	91.5	1.37	1063	115.0	2.09	813		5.38		
3101	86.0	1.65	1261	100.5	2.30	596	0	5.46	3	75
3102	82.5	1.66	1155	93.5	2.29	585		4.96		
3121	87.5	1.32	1318	108.5	2.08	698	2	4.66		
3122	79.5	1.52	1628	99.5	2.23	684		5.54		
3141	93.0	1.52	1392	108.5	2.20	754	4	5.34		
3142	84.5	1.34	1462	108.0	2.20	732		5.79		
3161	101.0	1.23	1953	136.0	2.10	548	6	7.06		
3162	92.0	1.32	1710	119.5	2.32	556		7.00		
201	295	0.95	11,430	520	1.65	2145	0	22.3	1	10°F.
202	450	1.05	12,740	820	2.80	1072		63.2		
221	360	1.03	10,350	515	2.08	1453	2	25.1		
222	575	0.89	15,100	805	2.20	1487		36.9		
241	510	0.66	20,650	1010	2.10	2162	4	63.3		
242	605	0.67	21,050	925	1.65	712		47.1		
261	595	0.43	20,750	1080	1.62	4170	6	54.9		
262	595	0.60	18,180	870	1.65	620		45.8		
201	700	0.50	32,550	1450	1.92	1213	0	85.6	2	10°
202	-	-	-	-	-	-		-		
221	1000	0.68	40,650	1575	1.78	3730	2	70.5		
222	950	0.48	44,050	1645	1.55	7715		60.6		
341	800	0.52	41.750	1625	1.60	8080	4	65.9		
242	1160	0.80	44,350	1695	1.70	7550		71.3		
261	1060	0.60	49,450	1825	1.45	6310	6	62.3		
262	965	0.48	25,950	1490	1.58	6095		84.6		
201	1000	0.49	34,750	1520	1.36	3885	0	68.6	3	10°
202	1010	0.43	33,450	1480	1.47	4460		70.0		
221	1020	0.42	29,950	1440	1.40	4210	2	67.5		
222	1160	0.54	39,850	1620	1.37	4135		66.9		
241	705	0.34	31,300	1450	1.60	6080	4	70.8		
242	930	0.48	44,500	1695	1.40	6605		65.5		
261	900	0.32	31,600	1640	1.50	7295	6	78.3		
262	900	0.46	36,800	1545	1.40	5635		58.9		

Table E-2 Analysis of Stress-Strain Curves For 2" Diam Compression Specimens.

E_m - Modulus of Elasticity
E_d - Modulus of Deformation
M_t - Modulus of Toughness.

Number	Yield Stress psi.	% Strain	E_m psi	Ultimate Stress psi.	% Strain	Ed psi.	% Poly.	Mt. in.#/in.	Age	Temp.
1301	150	.49	4820	318	2.40	1327	0	34.0	1	36°
1302	-	-	-	-	-	-				
1321	130	.41	5650	358	2.20	848	2	18.7		
1322	135	.33	6315	379	2.30	1015		26.8		
1341	155	.23	7340	455	1.70	1938	4	41.4		
1342	170	.24	6405	458	2.10	1585		46.6		
1361	150	.45	5620	318	1.60	1900	6	23.0		
1362	148	.41	5945	375	2.10	1723		31.4		
2301	176	.34	7305	480	2.20	1430	0	34.4	2	36°
2302	188	.39	7395	460	2.35	723		31.4		
2321	170	.43	7640	445	2.35	1095	2	31.6		
2322	190	.31	8500	483	1.90	963		36.9		
2341	183	.39	9965	459	2.17	1326	4	36.9		
2342	170	.24	7915	503	2.12	1655		33.6		
2361	195	.16	8075	596	1.83	2605	6	36.6		
2362	160	.24	8290	463	1.80	2065		25.2		
3301	185	.27	6940	461	2.15	1210	0	35.3	3	36°
3302	200	.31	7340	492	2.39	1248		34.2		
3321	200	.26	8415	561	2.20	1191	2	41.8		
3322	205	.22	8980	596	2.32	970		43.8		
3341	160	.15	8660	572	2.06	1995	4	39.3		
3342	170	.17	7095	492	1.75	2010		32.2		
3361	185	.15	8720	616	1.60	2020	6	36.1		
3362	185	.15	9060	610	2.00	1695		44.1		
1401	5.1	0.48	300	10.8	1.13	139	0	.27	1	140°
1402	4.1	0.43	80.1	7.1	0.93	99		.17		
1421	6.0	0.70	216	8.1	1.18	106	2	.23		
1422	6.0	0.70	160	6.5	0.98	111		.16		
1441	90.8	0.86	397	12.8	1.34	151	4	.41		
1442	8.3	0.55	314	13.1	1.10	157		.34		
1461	12.0	0.91	346	15.7	1.34	-	6	.43		
1462	14.0	0.84	251	18.8	1.25	-		.55		
2401	2.6	0.60	80.6	3.0	0.95	121	0	.10	2	140°
2402	5.6	0.60	204	8.3	1.16	89		.28		
2421	12.6	0.86	308	13.5	1.00	150	2	.30		
2422	11.6	1.00	319	12.8	1.11	124		.30		
2441	18.0	0.79	620	23.2	1.17	386	4	.57		
2442	18.0	0.79	624	23.9	1.17	408		.58		
2461	26.5	0.93	685	34.9	1.32	387	6	.93		
2462	25.8	0.95	761	32.8	1.30	431		.87		
3401	8.0	0.64	244	11.5	1.21	458	0	.36	3	140°
3402	6.2	0.66	165	7.8	1.12	110		.27		
3421	13.5	0.88	410	17.0	1.30	238	2	.49		
3422	14.0	0.83	442	17.9	1.29	265		.53		
3441	25.8	1.16	559	28.0	1.40	446	4	.77		
3442	24.5	1.00	636	27.5	1.30	373		.78		
3461	22.8	1.00	619	31.3	1.50	337	6	1.00		
3462	22.0	1.05	563	26.5	1.50	313		0.88		

TABLE -E-1
Analysis of Stress-Strain Curves
For 1"sq. x 6" long Tension Specimens.

Number	Yield Stress psi	Strain at Y.P. %	E_m psi	Ultimate Stress psi	Strain at U.S.	Ed psi	Modulus of Toughness in #/in.^{3}.	Age	Temp.	% Poly.
1101	1.4	0.41	53.5	2.55	1.60	25.0	0.20	1	75°F.	0
1102	1.9	0.41	60.0	3.10	1.25	40.0	0.127			
1121	2.0	0.70	66.7	2.80	1.35	-	0.184			2
1122	-	-	-	-	-	-	-			
1141	2.3	0.90	66.7	3.1	1.50	47.5	0.115			2
1142	2.3	0.90	66.7	5.1	2.30	85.0	0.285			
1161	9.6	1.65	136.8	11.8	2.50	240.5	0.790			6
1162	-	-	-	-	-	-				
2101	0.8	0.25	20.0	1.0	0.50	-	.05	2	75°	0
2102	0.8	0.25	20.0	1.4	1.00	-	.02			
2121	2.2	0.75	66.7	3.7	1.75	72.5	.155			2
2122	2.2	0.50	86.6	3.4	1.25	62.5	.127			
2141	2.6	0.40	137.0	7.4	1.70	125.0	.34			4
2142	2.6	0.40	137.0	6.1	0185	92.5	.167			
2161	-	-	150.0	-	-	82.5	.05			6
2162	5.1	0.55	160.0	10.6	1.55	28.5	.38			
3101	4.0	0.75	122.0	6.0	1.50	150.0	.23	3	75°	0
3102	1.1	0.20	45.5	3.1	1.55	45.0	.14			
3121	4.9	1.40	71.8	6.5	2.25	75.0	.35			2
3122	3.1	0.65	95.0	5.00	1.65	67.5	.24			
3141	8.2	1.00	163.5	12.80	2.05	-	.63			4
3142	4.2	0.60	215.5	7.60	1.65	-	.28			
3161	5.1	0.55	243.0	8.7	1.35	142.5	.22			6
3162	5.1	0.55	243.0	7.2	1.15	130.0	.30			
201	-	-	2250	285	2.70	--	12.0	1	10°F	0
202	-	-	3670	105	1.15	--	2.3			
221	-	-	6180	605	2.85	--	31.4			2
222	-	-	3090	220	1.85	--	8.2			
241	-	-	4230	505	1.80	--	12.3			4
242	-	-	2500	220	1.85	--	7.3			
261	95	0.55	6667	155	1.20	--	4.7			6
262	185	0.90	4165	315	1.63	--	10.5			
201	175	1.20	4000	255	1.70	--	22.2	2	10°F	0
202	180	1.40	3166	230	1.85	--	24.4			
221	195	0.90	7175	298	1.45	--	17.0			2
222	165	0.70	7830	293	1.45	--	18.7			
241	-	-	2400	300	1.50	--	12.3			4
242	200	0.87	6667	300	1.70	--	20.2			
261	90	0.40	3160	175	1.45	--	13.8			6
262	225	1.05	6333	285	1.45	--	16.3			
201	200	1.25	5000	255	1.80	--	19.0	3	10°F	0
202	185	0.90	5360	260	1.55	--	19.2			
221	200	1.35	6560	325	1.95	--	19.6			2
222	205	1.90	4165	280	2.70	--	33.6			
241	160	0.70	6000	235	1.09	--	10.8			4
242	180	0.85	5830	250	1.30	--	13.4			
261	320	1.25	6330	415	1.90	--	35.0			6
262	305	1.20	6330	335	1.40	--	16.9			

TABLE E- 2

Analysis of Stress - Strain Curves For
1" Square by 6" Long, Tension Specimens

Number	Yield Stress psi	% Strain at Y.P. %	E_m psi	Ultimate Stress psi	% Strain at U.S. %	Ed psi	Modulus of Toughness Ø psi	Age Ø	Temp. °F	% Poly.
1301	47.5	1.75	625	50.1	2.15	1628	4.46	1	36	0
1302	-	-	-	Missing	-	-	-			
1321	77.5	1.43	875	38.0	2.75	-	7.94			2
1322	45.0	1.65	656	50.5	2.40	-	3.06			
1341	78.0	1.35	1562	107.0	2.05	2250	4.84			4
1342	70.0	1.11	1250	102.0	2.00	2250	5.32			
1361	77.5	1.10	1830	113.0	1.75	2190	4.50			6
1362	75.0	1.00	2190	118.0	1.85	2190	4.92			
2301	42.0	0.93	1150	52.5	1.45	1190	1.86	2	36	0
2302	50.0	1.15	1062	71.0	2.00	1550	3.48			
2321	77.5	1.60	1188	107.5	2.50	-	-			2
2322	-	-	-	-	-	-	-			
2341	62.5	0.80	2170	95.0	1.50	3125	3.32			4
2342	-	-	-	-	-	-	-			
2361	85.0	1.33	2700	117.5	1.80	2380	2.72			6
2362	120.0	1.25	2875	158.0	2.13	3065	9.28			
3301	62.5	1.35	1563	106.0	2.05	2190	4.12	3	36	0
3302	62.5	1.00	1040	82.5	2.20	2750	5.14			
3321	41.0	0.43	2375	70.0	1.12	1250	2.20			2
3322	47.5	0.90	1250	127.5	2.25	1065	4.48			
3341	66.0	0.87	2080	100.0	1.65	2690	4.02			4
3342	108.0	1.07	2750	155.0	1.60	4640	5.04			
3361	127.5	1.11	2750	168.0	1.55	3125	5.24			6
3362	80.0	1.00	2335	100.0	1.50	2815	3.38			

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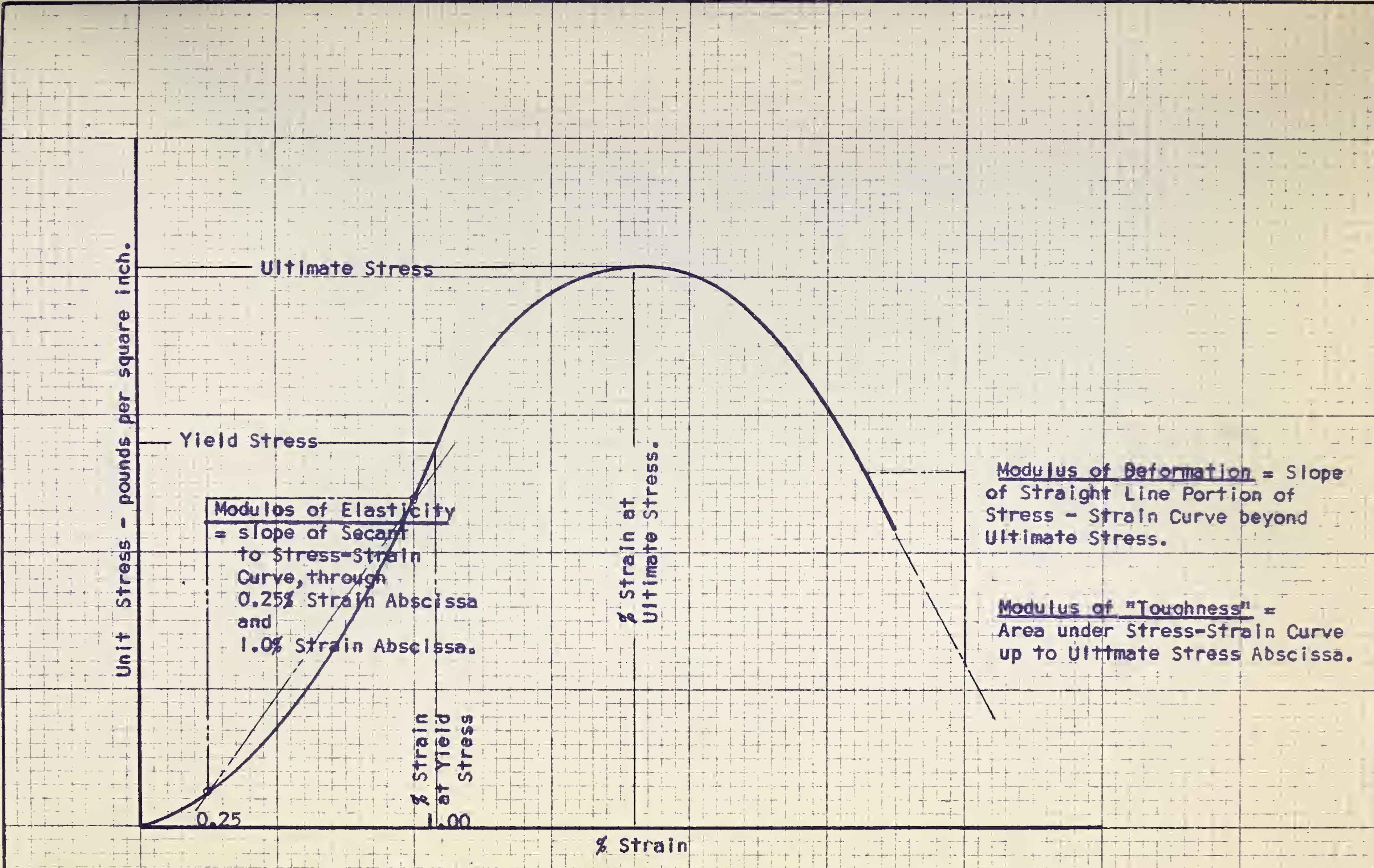
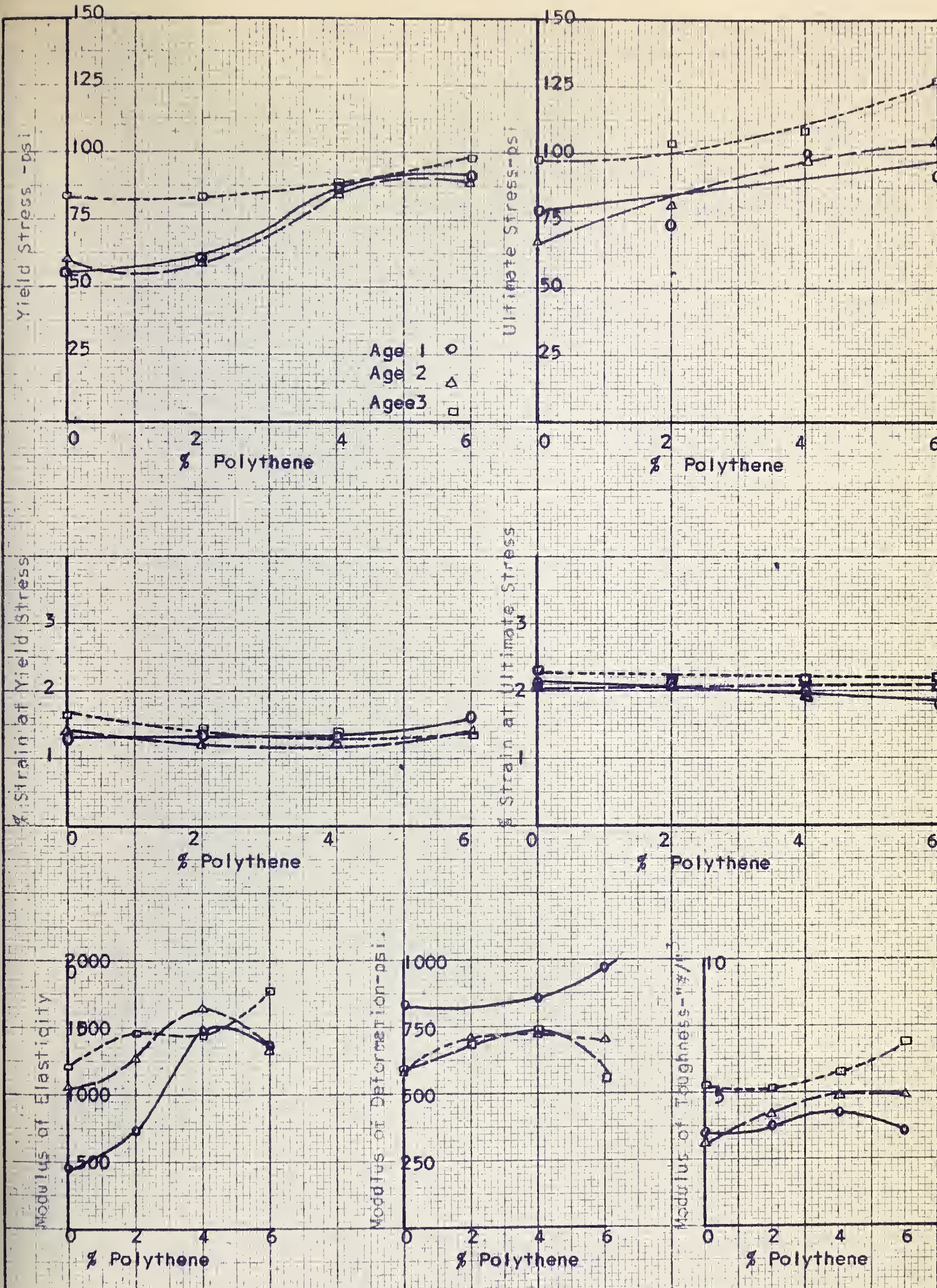
Note - Unable to obtain necessary data on this series. Refer to text.



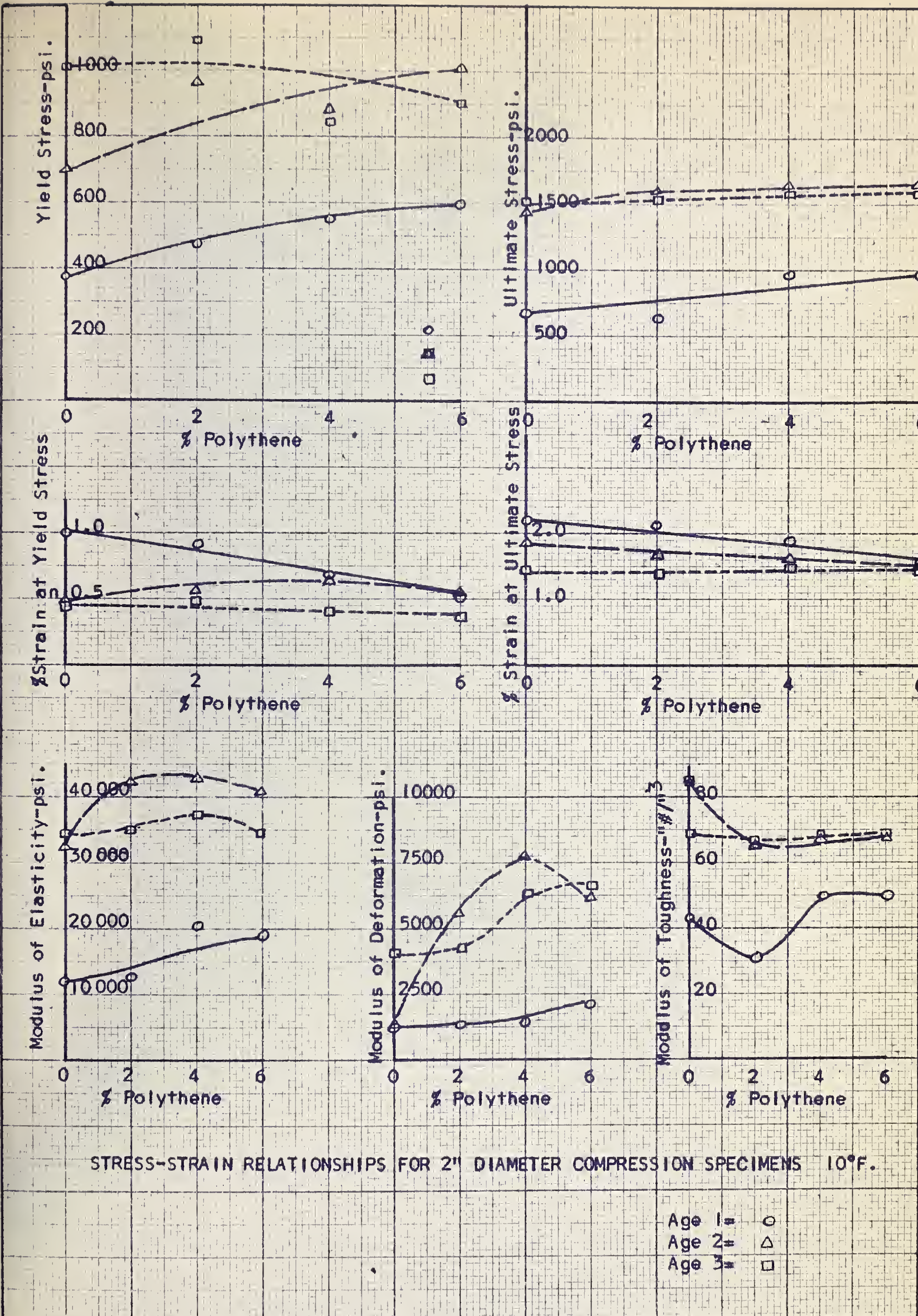
TYPICAL STRESS-STRAIN CURVE SHOWING THE VARIOUS FACTORS DETERMINED IN ASSESSING THE FUNDAMENTAL STRENGTH PROPERTIES OF COMPACTED ASPHALT MIXTURES.

PLATE 8.



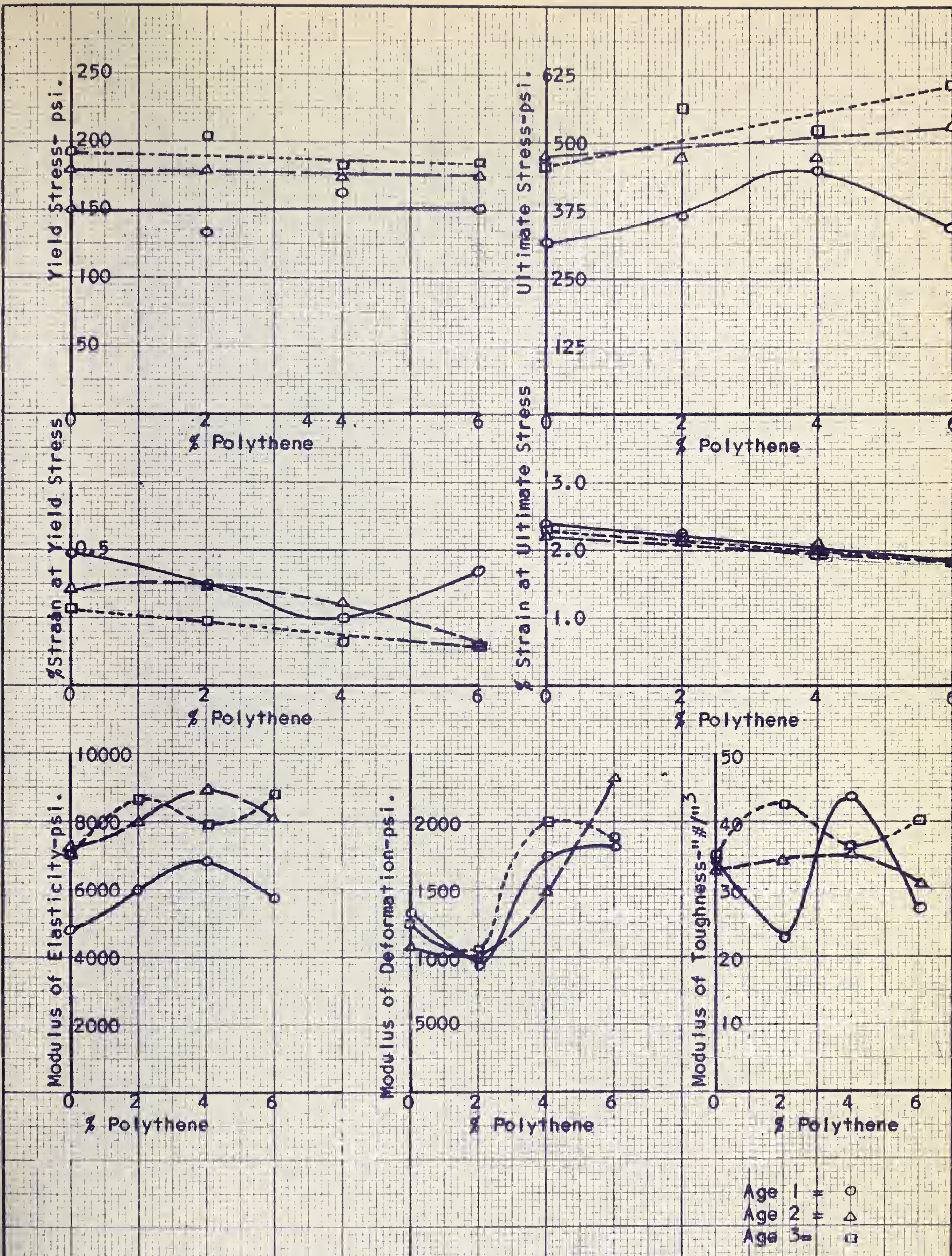
STRESS-STRAIN RELATIONSHIPS FOR 2" DIAMETER COMPRESSION SPECIMENS - 75°F.

PLATE 9



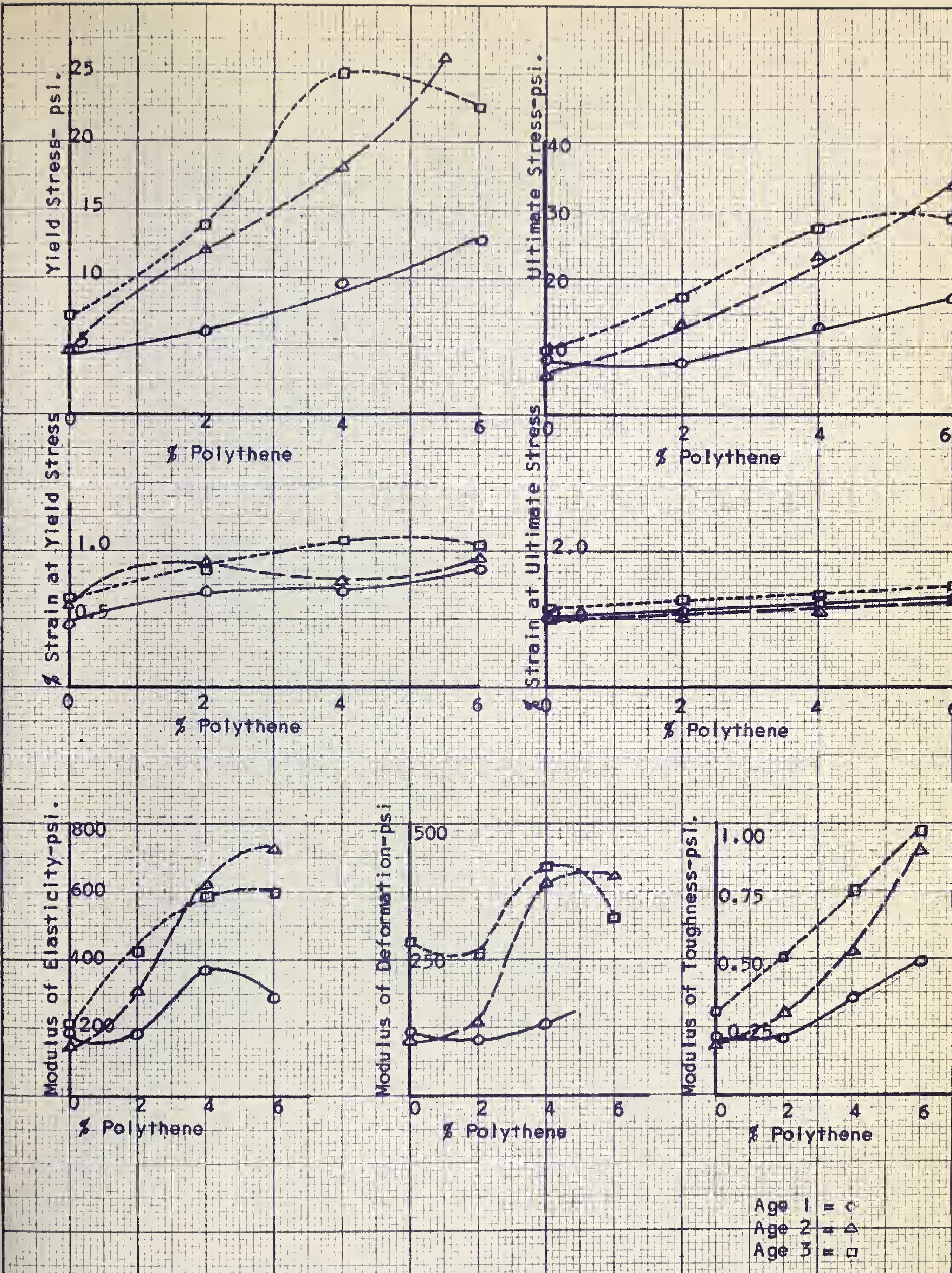
STRESS-STRAIN RELATIONSHIPS FOR 2" DIAMETER COMPRESSION SPECIMENS 10°F.

PLATE 10.



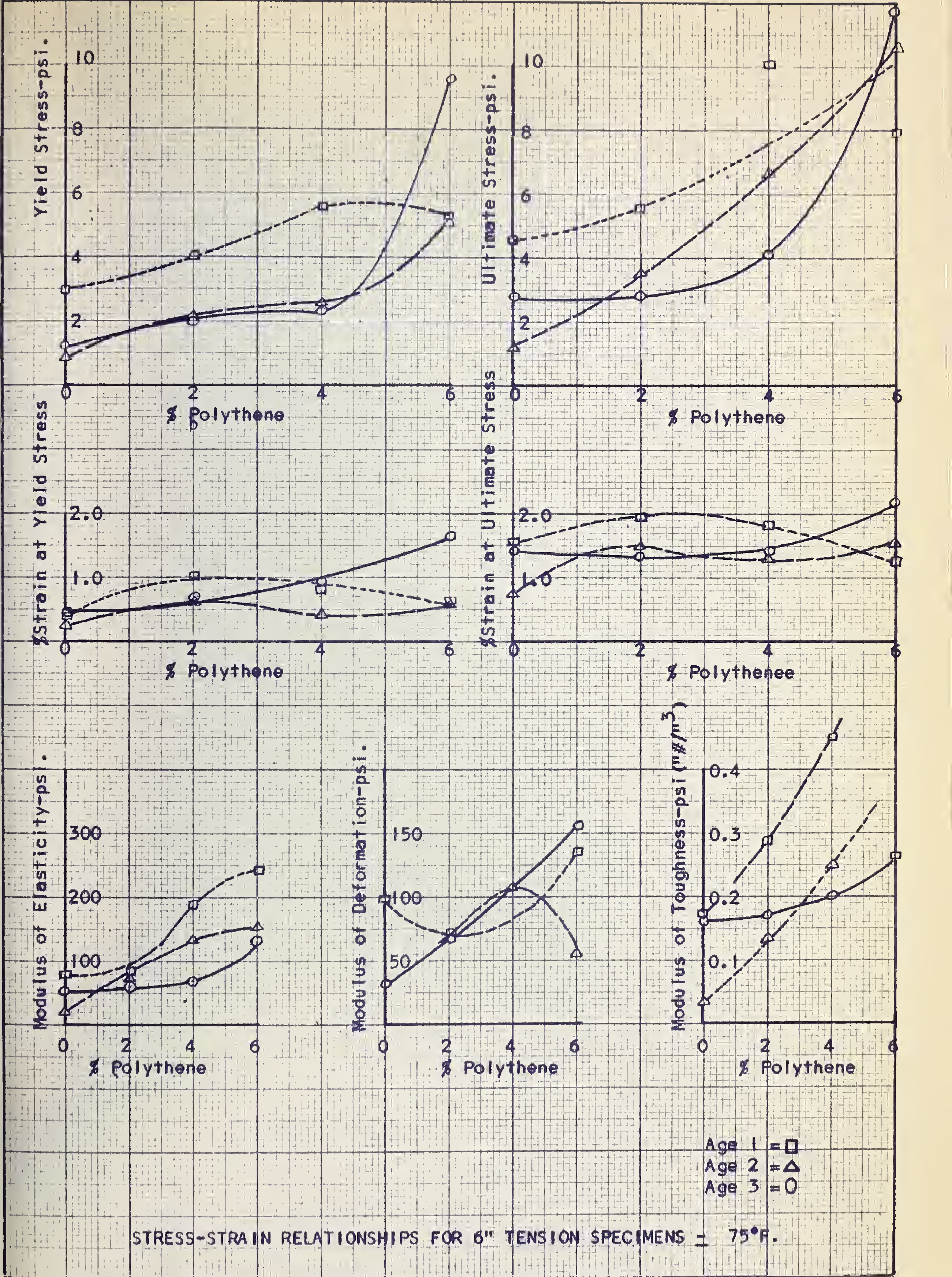
STRESS-STRAIN RELATIONSHIPS FOR 2" DIAMETER COMPRESSION SPECIMENS - 36°F

PLATE 11.



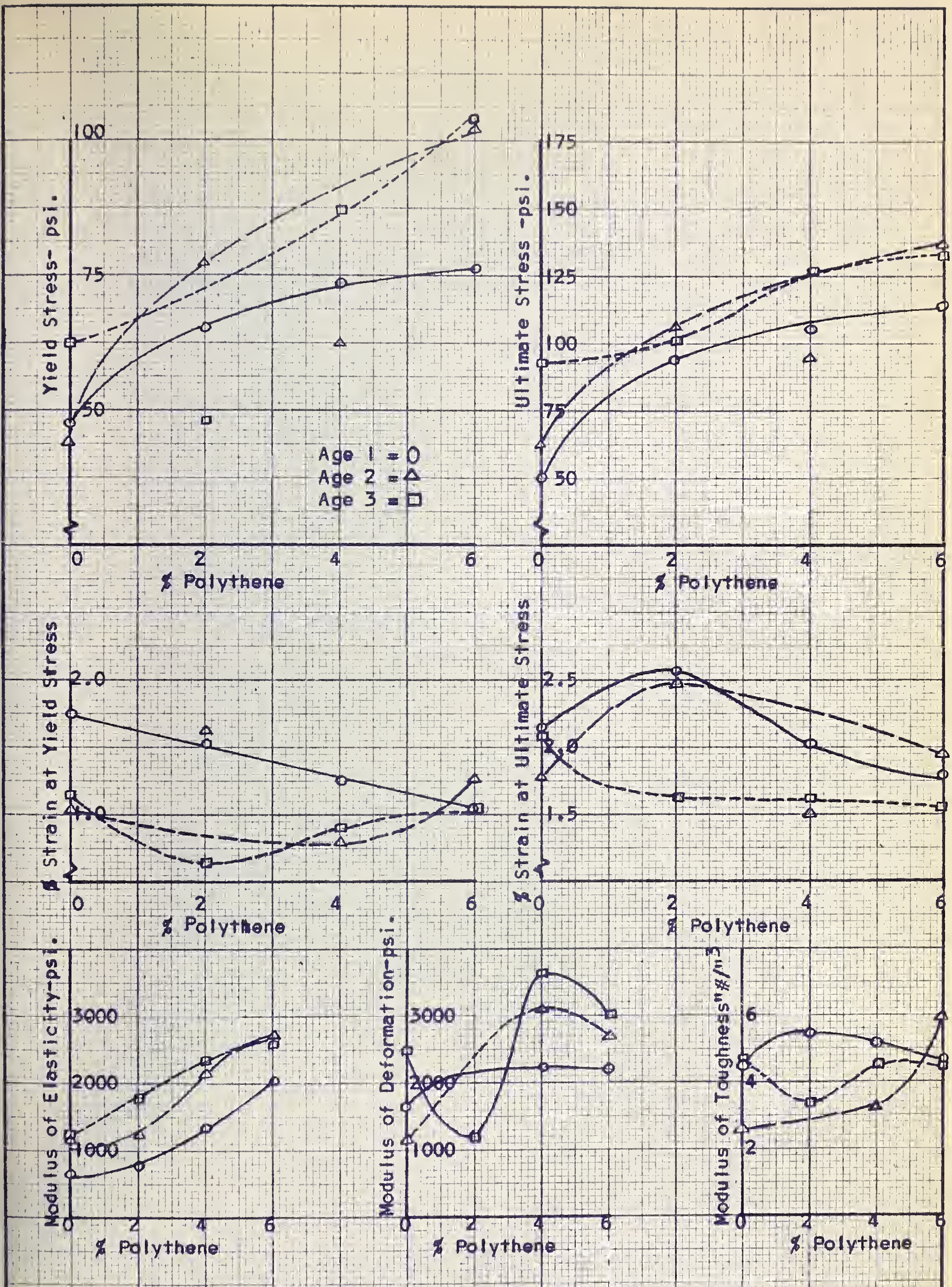
STRESS-SRRAIN RELATIONSHIPS FOR 2" DIAMETER COMPRESSION SPECIMENS- 140°F.

PLATE 12.



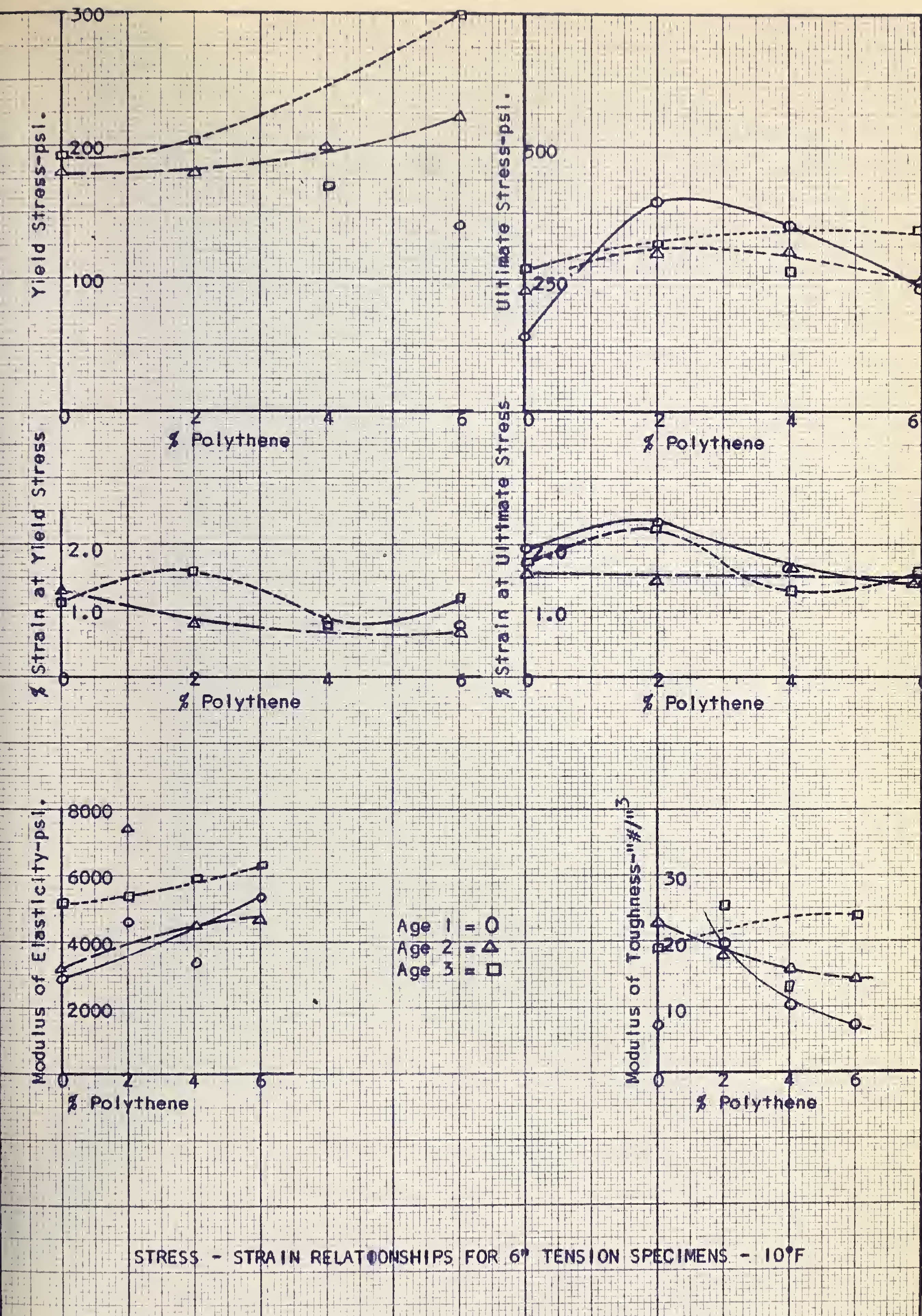
Yield Stress-psi.
% Polythene
Ultimate Stress-psi.
% Polythene
%Strain at Yield Stress
% Polythene
%Strain at Ultimate Stress
% Polythenee
Modulus of Elasticity-psi.
% Polythene
Modulus of Deformation-psi.
% Polythene
Modulus of Toughness-psi ("#/"^{3})
% Polythene
Age 1 = □
Age 2 = △
Age 3 = O
STRESS-STRAIN RELATIONSHIPS FOR 6" TENSION SPECIMENS ± 75°F.

PLATE 13.



STRESS-STRAIN RELATIONSHIPS FOR 6" TENSION SPECIMENS - 36°F.

PLATE 14



STRESS - STRAIN RELATIONSHIPS FOR 6" TENSION SPECIMENS - 10°F

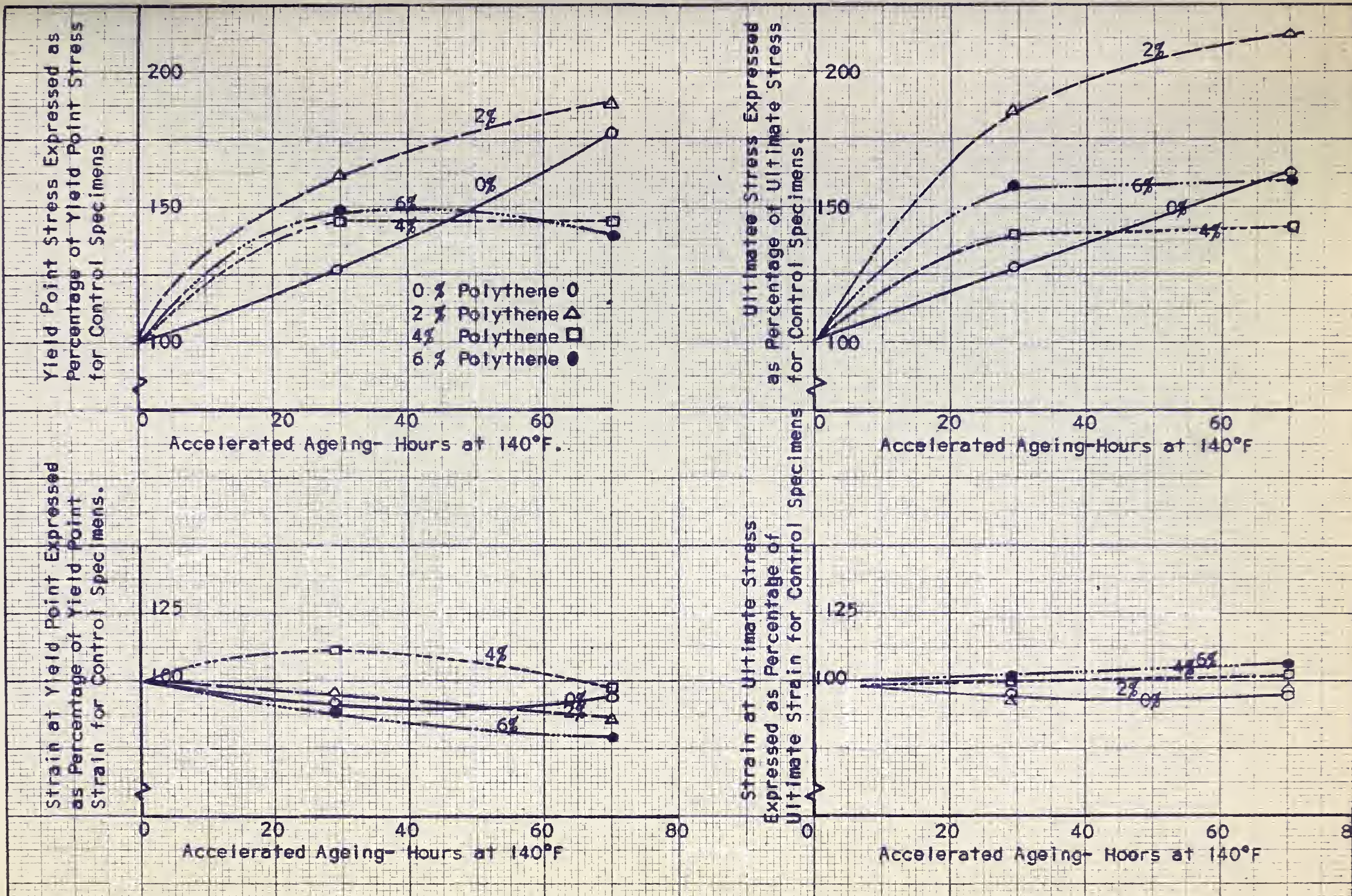
PLATE 15.

These curves show generally that there is an increase in yield point stress, ultimate stress, modulus of elasticity, and a slight increase in modulus of toughness when polythene is added to an asphaltic bitumen. In addition, while the % strain at the yield point and the ultimate stress is not changed appreciably at 75°F, it tends to increase with increasing polythene content at 140°F, and to decrease with increasing polythene content at 36°F and 10°F. The variation in modulus of deformability does not appear significant.

With regard to the tension specimen data, the scatter is so large that further interpretation seems fruitless. Hence the remainder of this discussion deals only with the compression specimens.

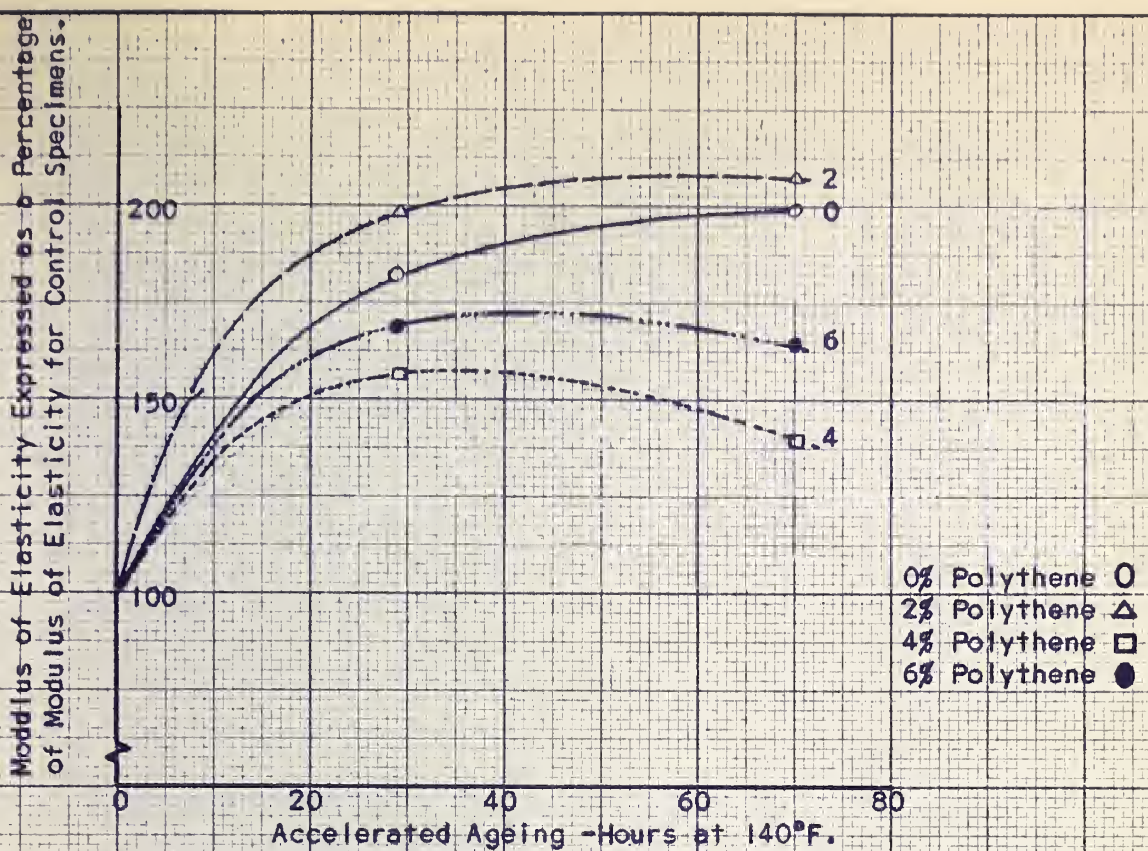
In an effort to evaluate the effect of polythene on the ageing characteristics of asphalt mixtures, the values of Table E were plotted against accelerated ageing, expressed as hours at 140°F with % polythene as the third variable. In this case, it has been assumed, for comparative purposes only, that the physical properties of the polythene in the asphalt binder do not vary appreciably in the temperature range used, and that therefore the effect of ageing on each specimen, at any one percentage additive, and at all temperatures, is approximately the same. Thus all the test values derived from the stress-strain curves, are expressed as a percentage of their value at zero percentage additive and a mean taken of the eight values (two at each temperature). In this way the effect of temperature on the physical magnitude of the values is eliminated. The results are shown on Plates 16 and 17.

[illegible]



EFFECT OF ACCELERATED AGEING ON STRESS-STRAIN PROPERTIES OF 2" DIAMETER COMPRESSION SPECIMENS.

PLATE 16.



EFFECT OF ACCELERATED AGEING ON STRESS-STRAIN PROPERTIES OF 2" DIAMETER COMPRESSION SPECIMENS.

PLATE 17.

It is interesting to note that the effect of the accelerated ageing process is to increase the yield stress, ultimate stress and modulus of elasticity, and to decrease slightly the percentage strain at the yield point and at the ultimate stress. However, it should be noted that the increase in these values is somewhat less at 2% polythene additive, and considerably less at 4% and 6% additive. In other words, the effect of the polythene in the asphaltic bitumen seems to be to reduce the effects of accelerated ageing, over those observed in mixtures without polythene. Also, while the increase of the value of these mechanical properties is almost a linear function of the time of accelerated ageing for the specimens without polythene, the specimens with polythene show an increase of these values and then, at 4% and 6% additive at least, almost no further increase beyond 29 hours accelerated ageing. This applies as well to the modulus of elasticity. Neither the modulus of deformability nor the modulus of toughness are shown here, since it proved impossible to derive any relationships from the data.

In order to assess the relative effects of the polythene additive at the different test temperatures employed, the values derived from the stress strain curves were plotted against testing temperature, with the percentage of polythene as the third variable, for each age group. Due to the great difference in magnitude of these values over the temperature range employed, it was necessary to plot each mean test value as a percentage of the test value at 75°F and 0% polythene. Thus, for any one age group, the ultimate stress at 0% polythene (the control specimens) and at 75°F assumed the value

of 100%, and all other values of ultimate stress were related to it. These relationships are shown on Plates 18 to 22 inclusive, with the found value, expressed as a percentage of the value at 75°F and 0% polythene plotted to a logarithmic scale, versus testing temperature to an arithmetic scale.

The general trend indicated by the curves for yield point stress, ultimate stress and modulus of elasticity, is that the effect of the polythene is of greater magnitude at elevated temperatures than at low temperatures. This can be seen clearly in Plate 19 which shows the relationship of ultimate stress, expressed as a percentage of the ultimate stress at 0% additive and 75°F. For the specimens aged for 29 hours at 140°F (Age 2) the ratio of the ultimate stress at 140°F and 6% Polythene to the ultimate stress at 140°F and 0% polythene is in the order of 50% to 8.5%, or about 6:1, while the ratio of the ultimate stress at 10°F and 6% additive to the ultimate stress at 10°F and 0% additive is in the order of 2,500% to 2,150%, or about 1.1:1.

Since the actual magnitude of the % strains at the yield point and at the ultimate stress were of the same order over the whole temperature range, they have been plotted to arithmetic scales on Plates 21 and 22. The yield point strain at 36°F is considerably lower than that at any other temperature. Reference to the stress strain curves for this group, Plates 37, 38 and 39, reveals that nearly all the curves exhibit little or no initial concavity upward, which is relatively common to the other groups. Under the methods of analysis employed, herein, this would tend to decrease the

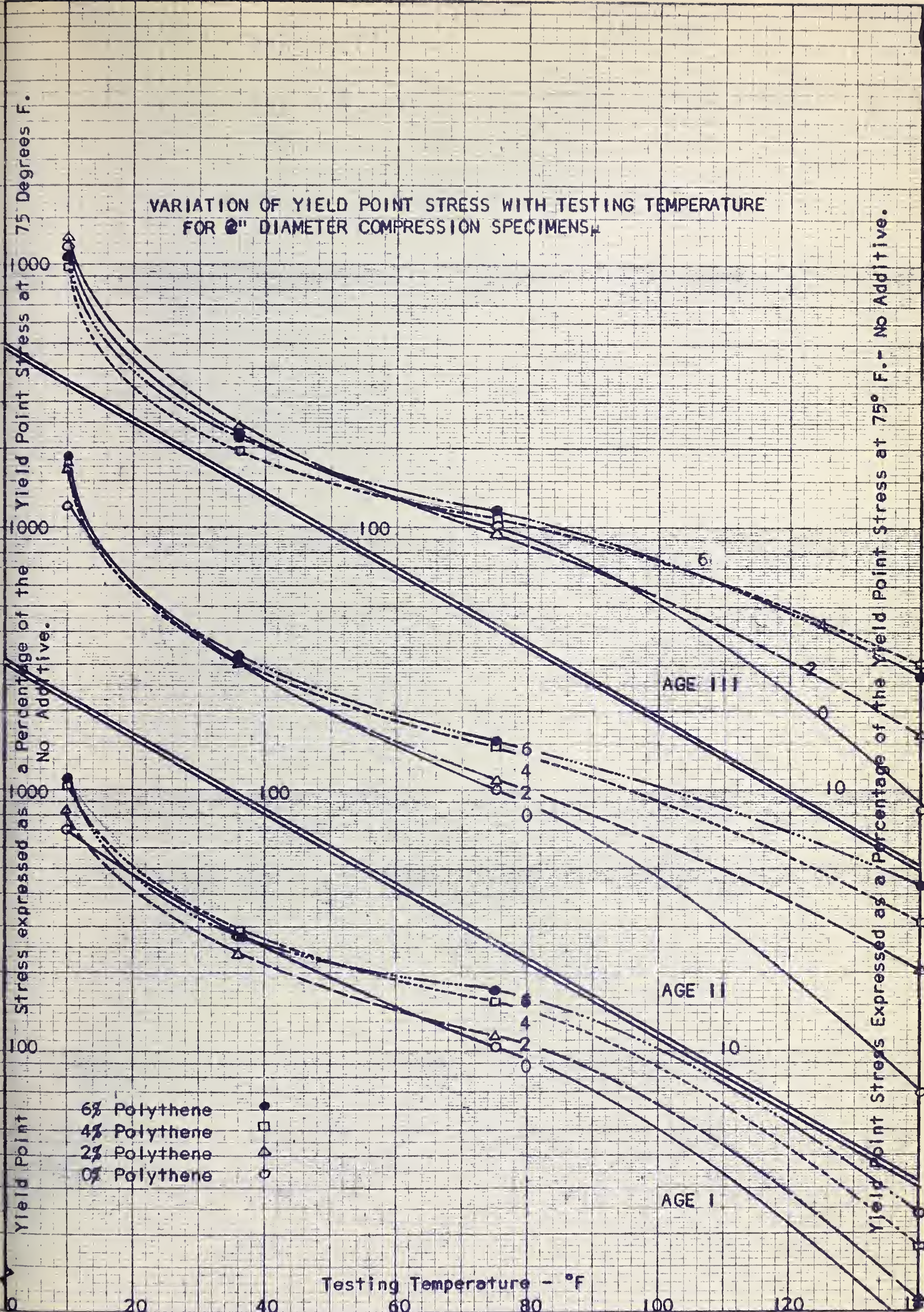
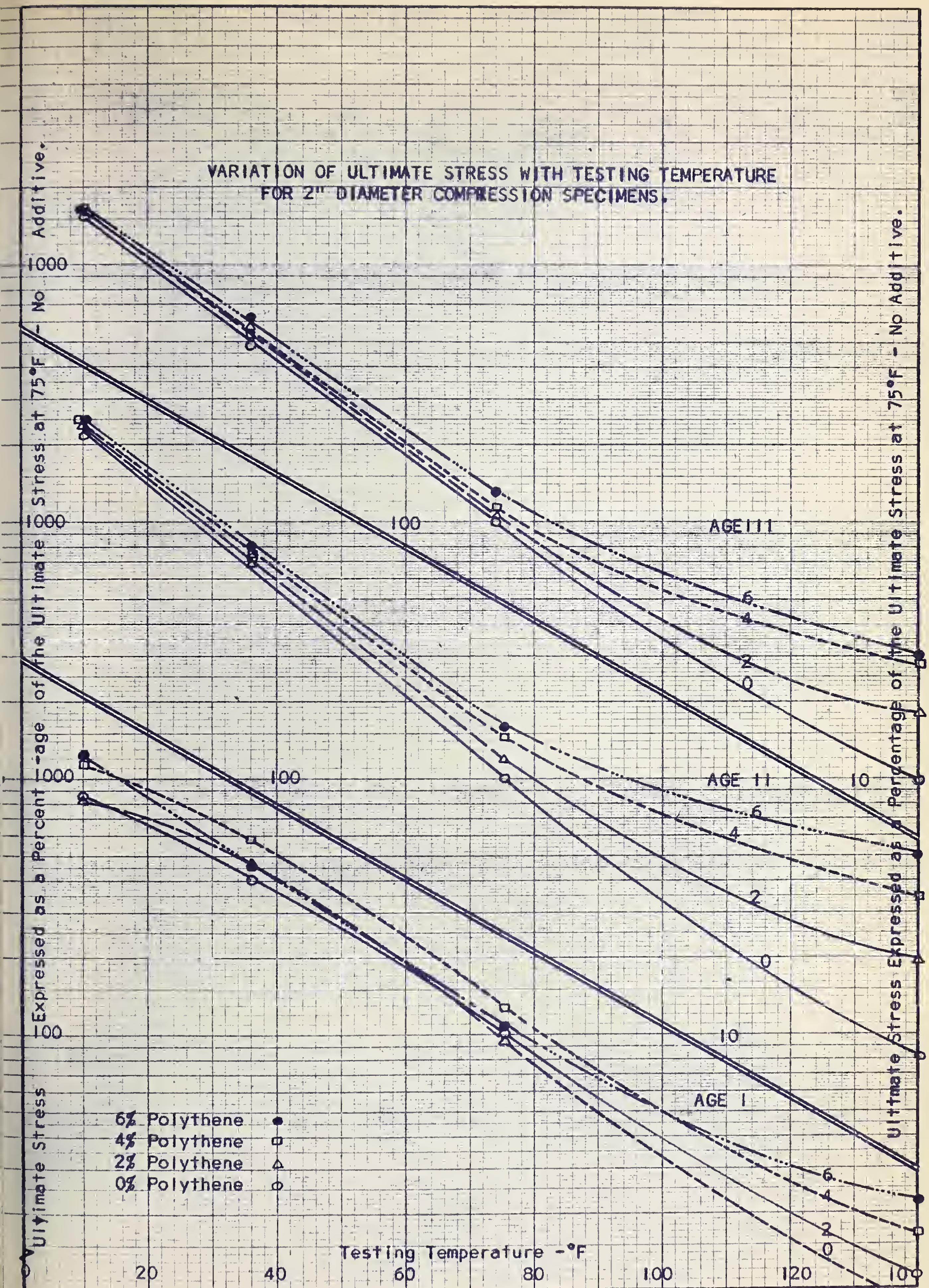

VARIATION OF YIELD POINT STRESS WITH TESTING TEMPERATURE
FOR 2" DIAMETER COMPRESSION SPECIMENS.
Yield Point Stress expressed as a Percentage of the Yield Point Stress at 75 Degrees F. No Additive.
Yield Point Stress Expressed as a Percentage of the Yield Point Stress at 75° F. - No Additive.
AGE III
AGE II
AGE I
6% Polythene
4% Polythene
2% Polythene
0% Polythene
Testing Temperature - °F
0
20
40
60
80
100
120
140
1000
100
10
6
4
2
0

PLATE 18.



VARIATION OF ULTIMATE STRESS WITH TESTING TEMPERATURE
FOR 2" DIAMETER COMPRESSION SPECIMENS.
Ultimate Stress Expressed as a Percent-age of the Ultimate Stress at 75°F - No Additive.
Ultimate Stress Expressed as a Percentage of the Ultimate Stress at 75°F - No Additive.
1000
100
10
AGE III
AGE II
AGE I
6
4
2
0
6% Polythene
4% Polythene
2% Polythene
0% Polythene
Testing Temperature -°F
20
40
60
80
100
120
140

PLATE 19.

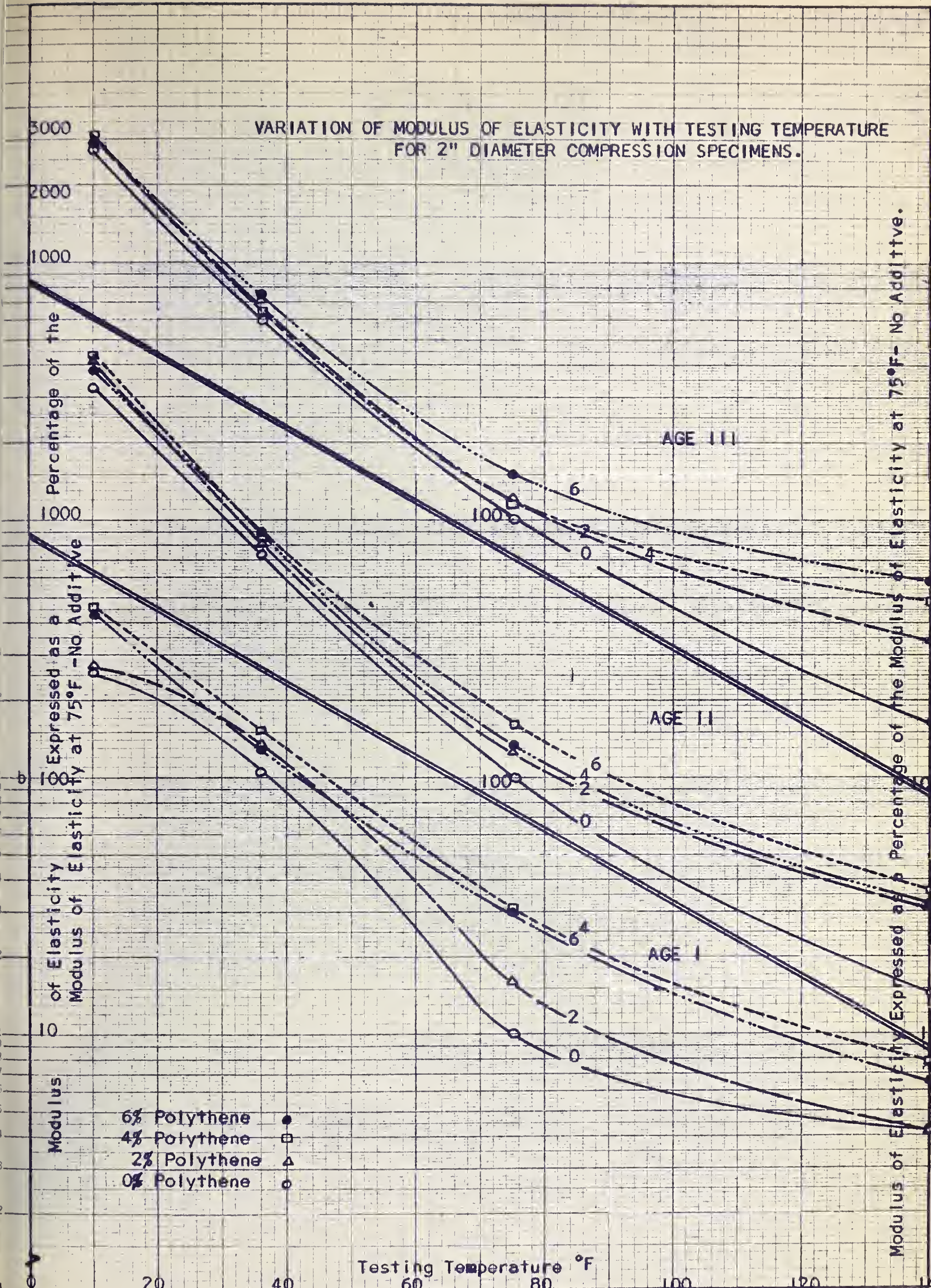

VARIATION OF MODULUS OF ELASTICITY WITH TESTING TEMPERATURE
FOR 2" DIAMETER COMPRESSION SPECIMENS.
Modulus of Elasticity Expressed as a Percentage of the Modulus of Elasticity at 75°F -No Additive
Modulus of Elasticity Expressed as a Percentage of the Modulus of Elasticity at 75°F- No Additive.
AGE III
AGE II
AGE I
6% Polythene
4% Polythene
2% Polythene
0% Polythene
Testing Temperature °F
3000
2000
1000
1000
100
100
100
10
0
20
40
60
80
100
120
140

PLATE 20.

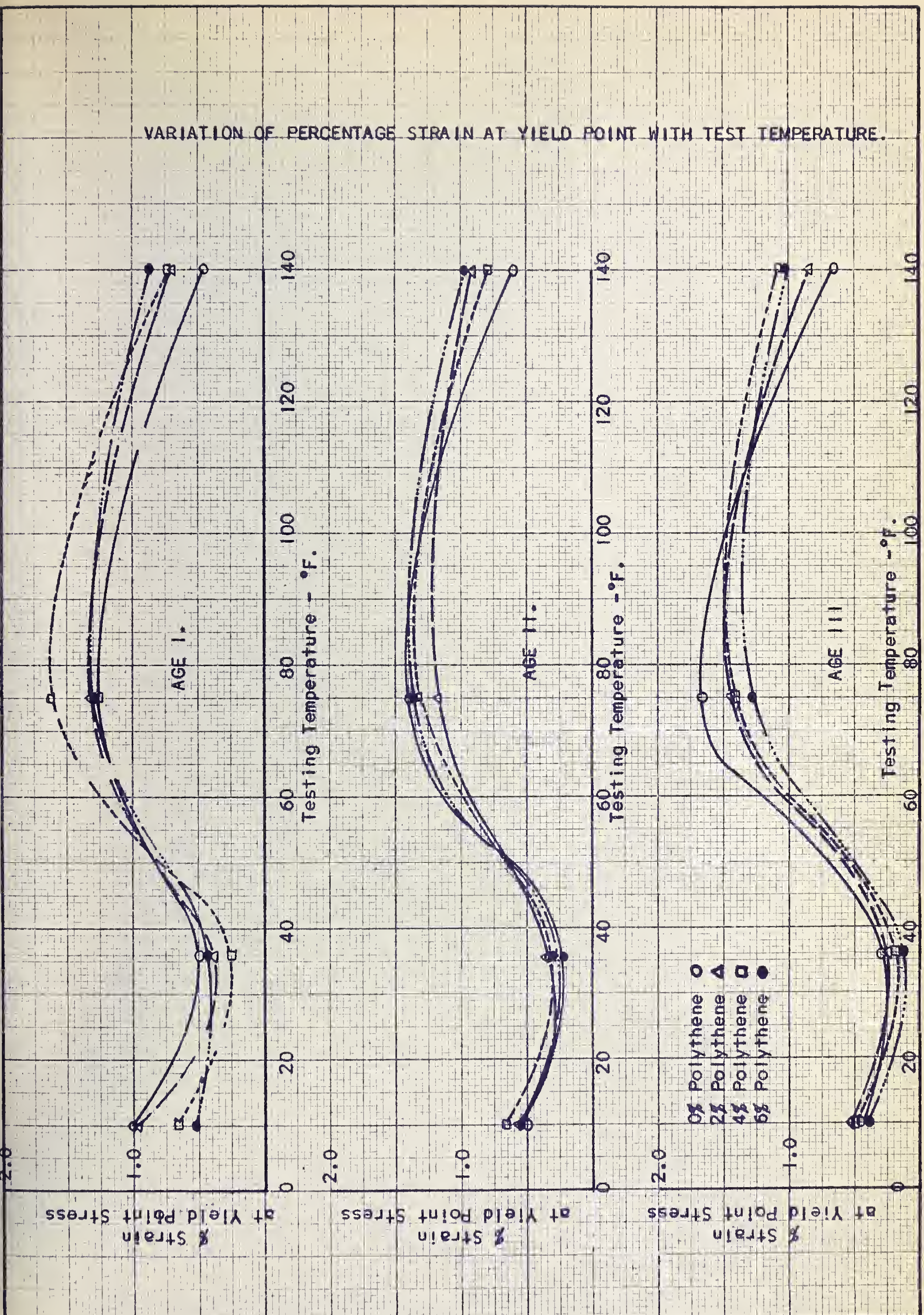

VARIATION OF PERCENTAGE STRAIN AT YIELD POINT WITH TEST TEMPERATURE.
AGE I.
AGE II.
AGE III
% Strain at Yield Point Stress
Testing Temperature - °F.
0% Polythene
2% Polythene
4% Polythene
6% Polythene
0
20
40
60
80
100
120
140
1.0
2.0

PLATE 21.

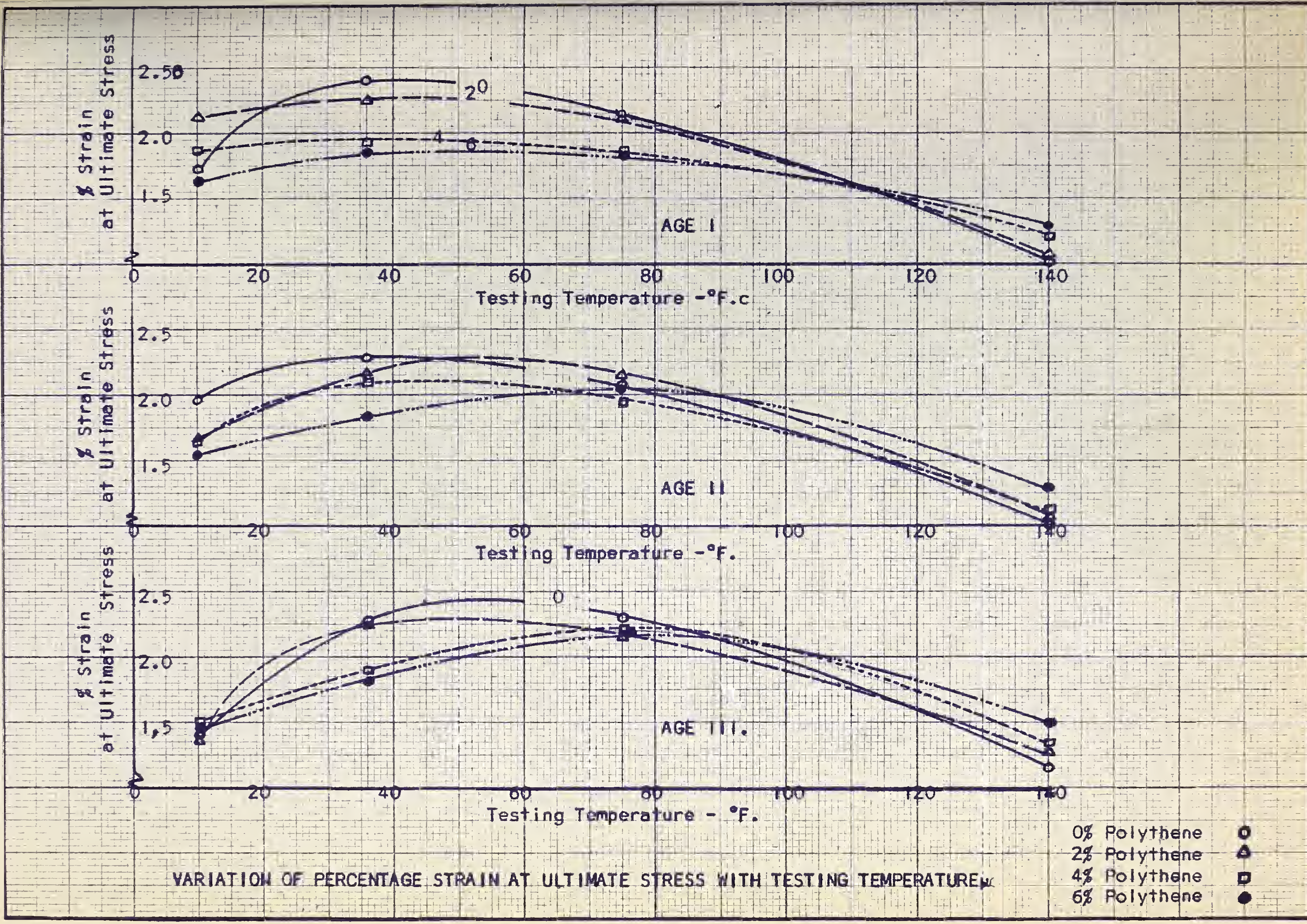

% Strain at Ultimate Stress
2.50
2.0
1.5
AGE I
0
20
40
60
80
100
120
140
Testing Temperature -°F.c
% Strain at Ultimate Stress
2.5
2.0
1.5
AGE II
Testing Temperature -°F.
% Strain at Ultimate Stress
2.5
2.0
1,5
AGE III.
Testing Temperature - °F.
0% Polythene
2% Polythene
4% Polythene
6% Polythene
VARIATION OF PERCENTAGE STRAIN AT ULTIMATE STRESS WITH TESTING TEMPERATURE.

PLATE 22.

yield point and the percentage strain at the yield point. Probably somewhat better initial seating conditions account for this effect. However, the most noticeable point on these graphs, is the fact that the polythene additive tends to increase both the yield point strain and the strain at ultimate stress, at elevated temperatures, while decreasing these values at lower temperatures, roughly in proportion to the amount of additive.

In general then, it is seen that the effect of polythene in the bituminous binder of a compacted asphalt mixture, is to increase the yield stress, and ultimate stress, and to reduce slightly the percentage strain at these two stresses. In addition there is a general tendency towards an increase in the modulus of elasticity, an increase in the modulus of toughness and the modulus of deformability. The effect of accelerated ageing on the magnitude of these values is reduced with increasing polythene content. The effect of the polythene is more noticeable at elevated temperatures than at low temperatures.

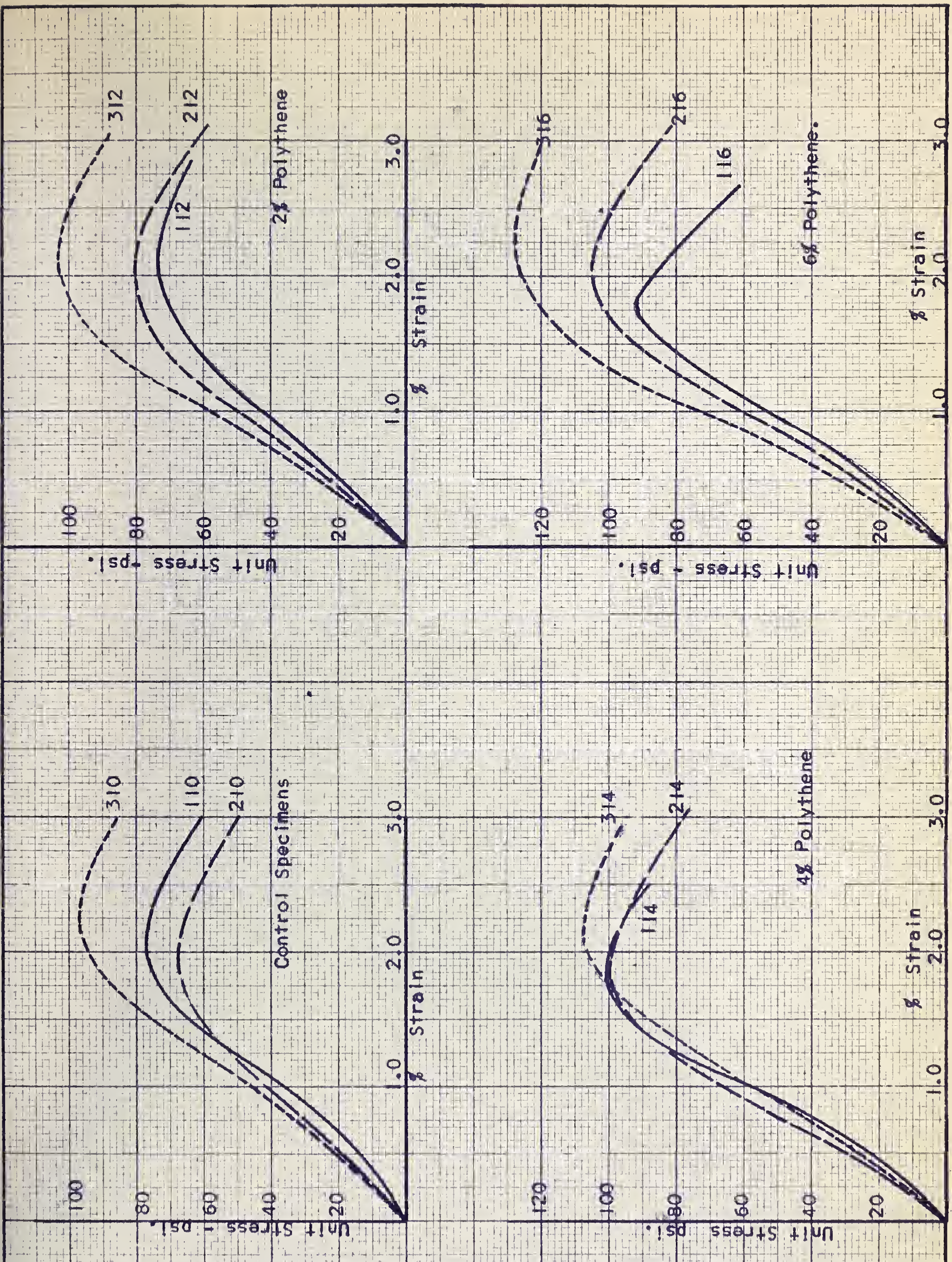
Now, the increased yield point, ultimate stress and modulus of elasticity associated with the addition of polythene to the mixture, indicates that the material becomes stiffer, and has a higher resistance to displacement. This would be expected since the binder has a higher viscosity when polythene is added to it, as reflected by the decided decrease in penetration. Even though increased stiffness is evident in these specimens, this does not imply increased brittleness, as it should be noted that the specimens with polythene withstood almost as much deformation before failure, as did the specimens without

polythene. This is reflected, to some extent, by the slight trend towards an increase in the "modulus of toughness".

It should be noted that the effects of polythene are of a measurable magnitude in compacted asphalt paving mixtures, even at 2% additive content by weight of asphalt cement. For the mixtures studied the polythene content is then 0.16% of the whole.

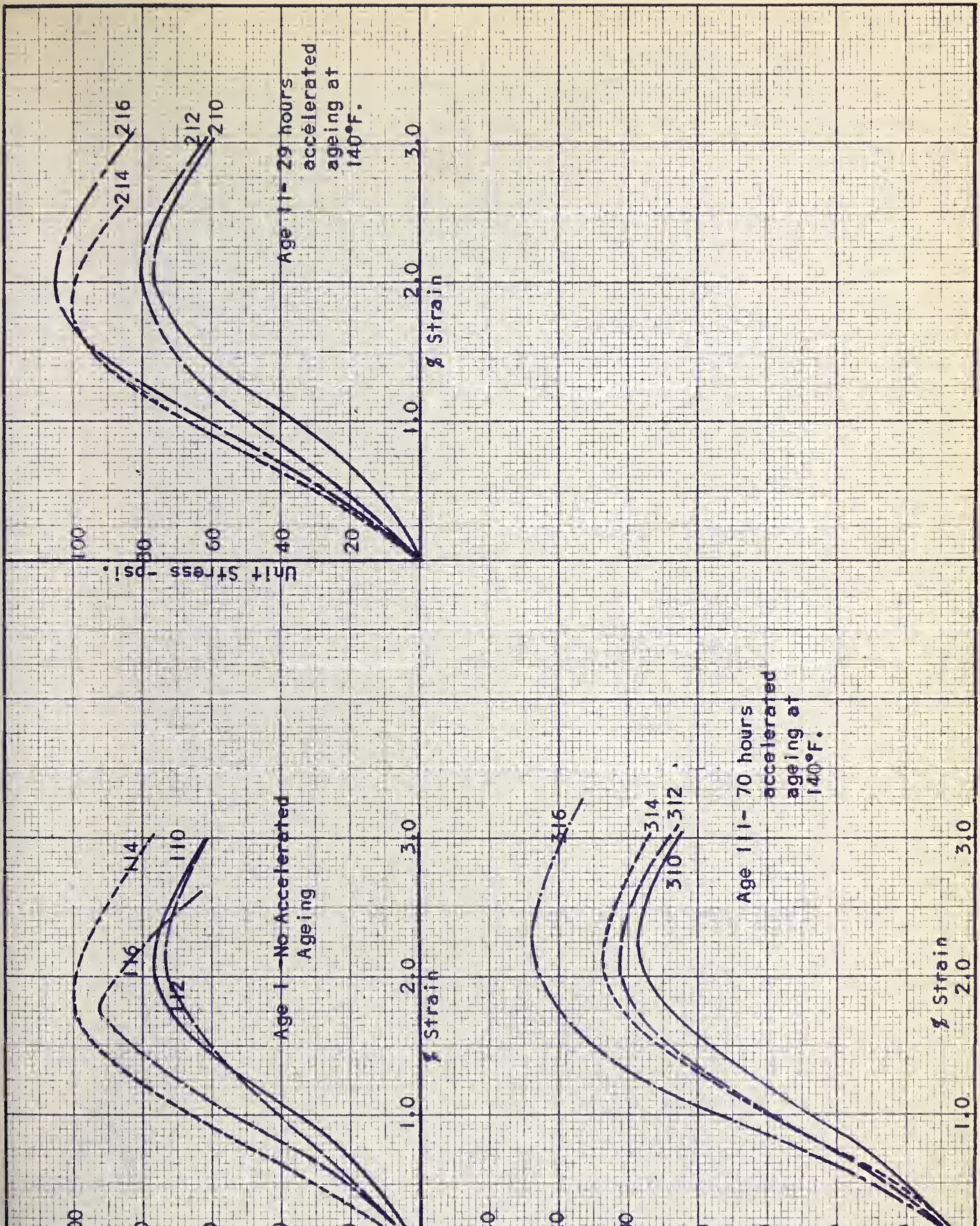
While the effect of polythene in the asphalt bitumen at low temperatures is not as pronounced as at normal and elevated temperatures, some advantage in securing greater durability may be derived from the fact that the polythene-asphaltic bitumen mixture is less soft at high temperatures in comparison to the original asphalt alone, which would permit the use of a softer asphalt than would otherwise be required. This effect could be that of stabilizing the paving mixture at an early stage and delay in the age at which the bitumen would become critically hard.

In order to clarify the preceeding discussion, some of the stress strain relationships derived from this investigation have been combined on Plates 23 to 26 inclusive, for both the tension and compression specimens. Plates 23 and 25 show the effects of accelerated ageing at each additive content for the specimens tested at 75°F. Plates 24 and 26 show the effects of polythene content for each accelerated age group. These curves show that in general there are some beneficial effects to be derived from incorporating polythene in asphalt paving mixtures.



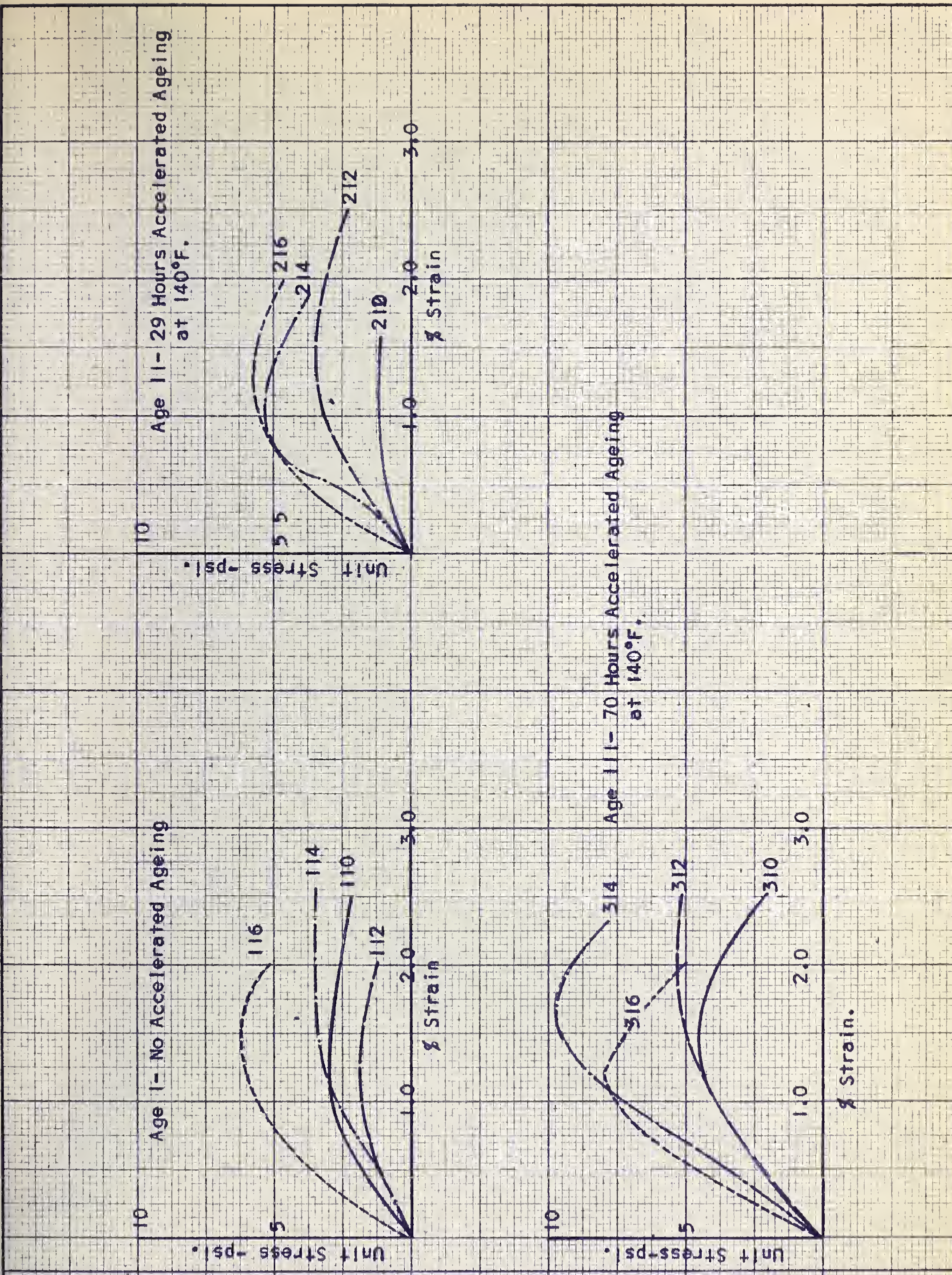
EFFECT OF ACCELERATED AGEING PROCESS ON STRESS-STRAIN PROPERTIES OF 2" DIAMETER COMPRESSION SPECIMENS AT 75°F, WITH VARIATION IN POLYTHENE CONTENT.

PLATE 23.



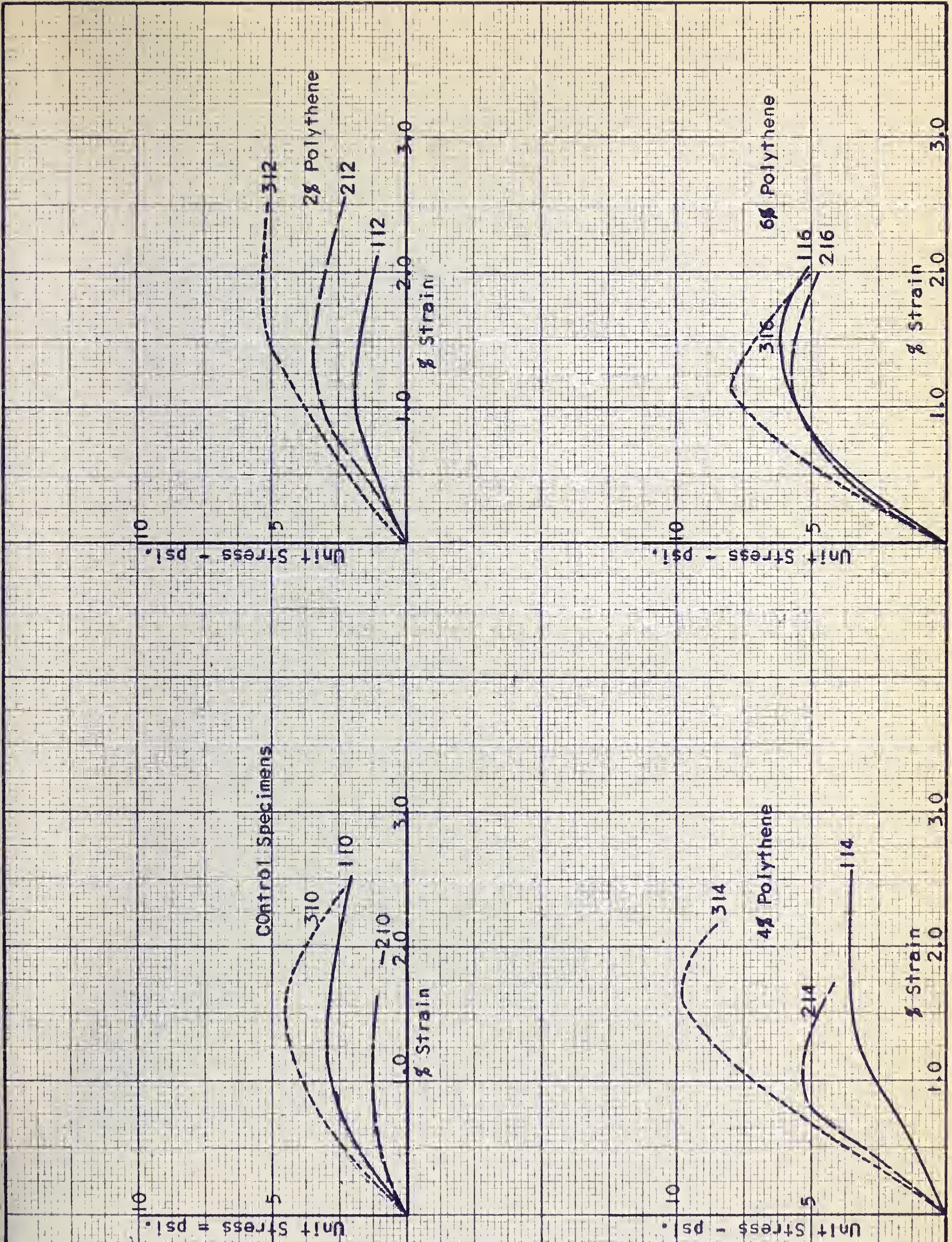
EFFECT OF POLYTHENE CONTENT ON STRESS-STRAIN PROPERTIES OF 2" DIAMETER COMPRESSION SPECIMENS AT 75°F, WITH VARIATION IN ACCELERATED AGEING FACTOR.

PLATE 24.



EFFECT OF POLYTHENE CONTENT ON STRESS-STRAIN PROPERTIES OF 6" TENSION SPECIMENS AT 75°F, WITH VARIATION IN ACCELERATED AGEING FACTOR.

PLATE 25.



EFFECT OF ACCELERATED AGEING PROCESS ON STRESS-STRAIN PROPERTIES OF 6" TENSION SPECIMENS AT 75°F, WITH VARIATION IN POLYTHENE CONTENT.

PLATE 26.

TYPICAL FAILURES EVIDENCED BY UNCONFINED COMPRESSION AND TENSION SPECIMENS.

PLATE 27.

Considering the program in its entirety, it may be seen that the approach to this investigation has been to assess the effect of polythene on some of the fundamental properties of bituminous mixtures. The effects of ageing on these properties has been evaluated by a strictly empirical procedure, and the ultimate effect on the durability of paving mixtures with the addition of polythene, is still a matter of conjecture.

Both the mixing procedure and testing procedure are admittedly crude, and would have to be modified considerably in future investigations. This is particularly true of the tension test specimens, which evidenced large deviations in results. Some of this may be attributed to small eccentricities in loading, which at low temperatures would be magnified considerably, complicating the stress conditions in the specimen. However some of the disparity noted is due probably to random distribution of the aggregate particles in the mixture. Thus a concentration of large particles at the narrowed center section, would result in a different failure stress than when the particles were distributed more normally. In future investigations along these lines, it would appear profitable either to utilize a finer mixture, or somewhat larger specimens. Also, a probable minimum of four specimens at each combination of test variables would produce more significant results.

To date, it has not been possible to reclaim the polythene-asphalt binder from the test specimens in order that the change in rheological properties due to accelerated ageing process might be assessed in terms of penetration, ductility and softening point. Whether such a procedure should be carried

out is doubtful, as the change in properties could only be evaluated empirically, and the trend is already indicated by the compression and tension tests reported herein. Possibly as much information could be obtained by recourse to thin-film exposure tests. (10).

It should be emphasised that the tests performed in this investigation of the properties of compacted mixtures, were selected for their fundamental nature. The actual critical stress conditions existing in a well designed pavement are most probably due to repeated bending, and at low temperatures. A rational approach to assessing the properties of polythene-asphalt mixtures under these conditions would seem to be to utilize a flexure-fatigue apparatus of the type employed by Gregg (15).

The ultimate criterion of the suitability of an asphalt mixture is its performance in actual service. However, at this stage, there is not sufficient evidence of the advantages to be derived from incorporating polythene in asphalt cements of paving grade, to warrant such a program.

The investigations so far indicate that the use of polythene in asphalt mixtures is of some benefit. Future investigations could be directed most profitably towards a comprehensive investigation of the mixing process, using the "waste" polythene described heretofore, and a variety of asphalt cements. Possibly an analysis of the constituents of the polythene-asphalt mixtures, using the simplified precipitation method of Csanyi and Fung (24), would help to clarify the mixing phenomenon.

Much additional data could be obtained by carrying out parallel tests using rubberized asphalt binders, in order that a more comprehensive comparison be made, than has been possible at this stage.

CHAPTER VI

CONCLUSIONS

Consideration of the preliminary nature of this investigation, and the rather wide deviation of results obtained, makes it unwise to draw any specific conclusions. However, in view of the trends established, it can be inferred that:

(i) Incorporation of commercial polythene granules with soft asphalt cements, by the process utilized herein, results in a decrease in normal penetration, ductility and temperature susceptibility, and an increase in softening point of the mixture.

(ii) These changes in rheological properties are reflected by an increase in the yield point stress, ultimate stress, modulus of elasticity and modulus of toughness, and with a slight decrease in the percent strain at both yield point stress and ultimate stress.

(iii) The presence of polythene in a compacted bituminous mixture appears to reduce the rate of ageing effects.

(iv) The effect of polythene appears more pronounced at elevated temperatures than at low temperatures.

(v) The overall effect would appear to indicate an improvement in the quality of bituminous mixtures through the incorporation of polythene.

RECOMMENDATIONS FOR FUTURE RESEARCH

In view of the results of this preliminary investigation, which indicate some beneficial effects to be obtained from the incorporation of polythene in asphalt paving mixtures, it is recommended that future research be directed along the following lines:-

(1) A comprehensive investigation of the mixing process, with assessment of the rheological properties of several asphalt cements from different sources, including both cracked and uncracked asphalts, and analysis of the constituents of polythene-asphalt mixtures.

(ii) Investigation of the durability of polythene-asphalt paving mixtures, utilizing accelerated ageing techniques, and development of some type of testing technique such as a flexure-fatigue machine used in corresponding rubber[illegible]-asphalt research.

(iii) Subsidiary investigations on rubber-asphalt mixtures, in conjunction with the program recommended in section (ii), in order to provide a more direct comparison between the two types of additive, and to assess the economic feasibility of polythene asphalt mixtures, as a means of increasing the durability of asphalt pavements.

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APPENDIX "A"

1. PROCEDURE FOR INCORPORATING POLYTHENE IN ASPHALT CEMENT.

   (a) Tare aluminum mixing bowl to nearest 0.01 grams.

   (b) Heat asphalt cement to 250-275°F. and pour approximately 500 grams into bowl.

   (c) Allow bowl to cool for approximately 1 hour, then weigh bowl plus asphalt to nearest 0.01 grams.

   (d) Compute weight of asphalt cement, and weigh out sufficient polythene, to nearest 0.01 grams, to required percentage.

   (e) Place bowl over source of heat, and heat to 390-410°F.

   (f) Lower variable speed stirrer into hot asphalt, and stir for two minutes, at lowest speed (100 R.P.M.).

   (g) Add polythene granules to mixture over next ten minutes, with stirrer operating.

   (h) Continue stirring for total period of twenty minutes.

   (i) Stop stirrer, remove from mixing bowl. Pour contents of bowl into sample tins.

2. PROCEDURE FOR FABRICATING TEST SPECIMENS.

   A-Heating and Mixing Process.

   (a) Pour previously weighed aggregate batch into an aluminum pan and heat in oven for period of not less than one hour at 350-375°F.

   (b) Heat asphalt cement to 250°F. in constant temperature oven. Do not heat asphalt specimen for more than 2 hours maximum.

   (c) Place mixing bowl on 20 kg. solution balance and tare off weight of bowl. Set on wt. of aggregate.

(d) Remove aggregate batch from oven, and pour into mixing bowl. Dust fines from heating pan into mixing bowl. Check weight of gravel specimen, and adjust to true weight if necessary.

(e) Premix dry aggregate for no more than 30 seconds and then form a shallow crater at the center.

(f) Compute the weight of asphalt to be added to give required asphalt content (expressed as percentage by weight of dry aggregate), and set this off on scale bar.

(g) Remove asphalt from constant temperature oven, and spoon asphalt into center of crater until scale balances. Replace asphalt pot in constant temperature oven.

(h) Mix asphalt and aggregate with a broad bladed spatula (4" long x 1" wide) until all particles appear well coated and mixture is homogeneous. Use an alternate spooning and smearing action. The mixing must take no less than 30 seconds or more than 2 minutes. If longer, mixture must be discarded.

2-B. <u>FABRICATION OF COMPRESSION SPECIMENS</u>.

(a) Set up compression mould (Plate IV) on circular jig with lower plunger extending 1/2" into mould. Grease inside of mould and plunger thoroughly.

(b) Spoon in sufficient of the hot asphalt mixture to fill the mould to 2/3 the depth.

(c) Rod the mould 25 times with a thin bladed ($4\frac{1}{2}$"x$\frac{3}{4}$") spatula, distributing the roddings across the section, and around the periphery of the sample.

(d) Fill the mould to the top, and rod this second lift 15 times.

(e) Complete filling the mould, rod this 10 times and smear the top level.

(f) Press on the top plunger, and rotate under hand pressure to assure a good contact surface.

(g) Remove circular jig, and place mould with plungers on Tinius Olsen testing machine.

(h) Set load holder to required pressure (2860 kg.).

(i) Apply load at a constant rate in one minute. Maintain load at maximum for one minute, then release at approximately 10 psi/second.

(j) Remove mould from testing machine. Extract plungers and place mould in cold water bath for a period of about 5 minutes.

(k) Split mould and knock specimen out of mould.

(l) Measure and record height and weight of specimen.

2-C FABRICATION OF TENSION SPECIMENS.

(a) Assemble mould (Plate IV) and place on steel base plate. Grease plate, inside of mould, and compaction head.

(b) Spoon in sufficient of the hot asphalt mixture to fill the mould to 2/3 depth.

(c) Rod the mould 50 times with a thin bladed spatula ($4\frac{1}{2}$" x $\frac{3}{4}$"), distributing the roddings over the area of the mould, and around the periphery of the specimen.

(d) Fill the mould to approximately 1/8" above the top, and repeat the rodding procedure.

(e) Trim the excess mixture from the surface, smearing the surface with a spatula.

(f) Press on the compaction head, making certain that the head can move freely inside the mould.

(g) Place base plate with mould, specimen and compaction head on bed plate of laboratory Tinius Olsen testing machine.

(h) Set load holder to required total load (9350 kg. = 2500 psi)

(i) Apply load at a constant rate in one minute. Maintain load for one minute, then release at approximately 20 psi per second.

(j) Remove mould from testing machine. Remove base plate and compacting head, and place mould in cold water bath for about 5 minutes.

(k) Disassemble mould, and knock specimen from sides.

(l) Measure specimen and obtain weight. Use di water displacement method to obtain volume.

Note:- All dimensions taken to nearest 0.01". For tension specimens this will normally require setting up a temporary jig employing an extensometer dial, utilized as a feeler gauge.

APPENDIX "B"

PROCEDURE FOR TESTING COMPACTED BITUMINOUS SPECIMENS

(a) Set up apparatus for test required (See Plates V and VI).

(b) Place specimen on bed plate (or in case of tension specimen, slide into clips) and seat specimen with following loads:

At	$140^{\circ}F$	-	0.5# on 25# Proving Ring.
	$75^{\circ}F$	-	5# on 600# Proving Ring.
	$36^{\circ}F$	-	10# on 600# Proving Ring (Tens.).
		-	20# on 10,000# Proving Ring (Comp.).
	$10^{\circ}F$	-	as for $36^{\circ}F$ conditions.

(c) Set deflection dial on base plate for compression specimen, or on extension arm for tension specimen and set dial to zero. Set proving ring dial to zero.

(d) Switch on electric motor. Record proving ring dial readings for each 0.01" deflection until specimen fractures or until proving ring dial reading has decreased for at least four successive readings.

(e) Compute actual total strain as recorded strain minus proving ring deflection.

(f) Compute % strain as actual strain divided by gauge length, multiplied by 100. Gauge length for compression specimens is the original measured height of the specimen. Gauge length for tension specimens is equal to the length of the narrowed center section (4").

[illegible]

[illegible]

[illegible]

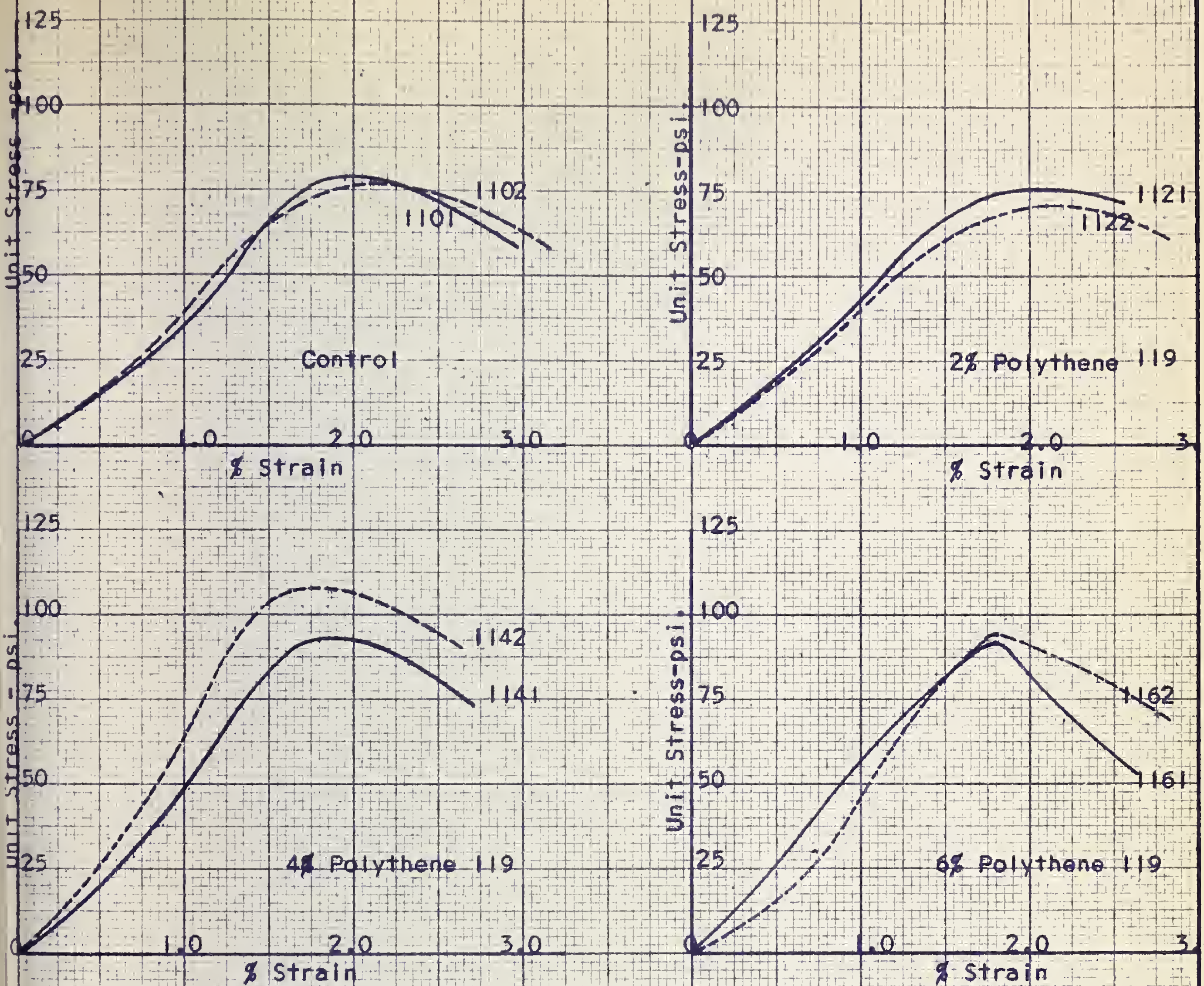
[illegible]

(g) Compute total load from proving ring calibration charts.

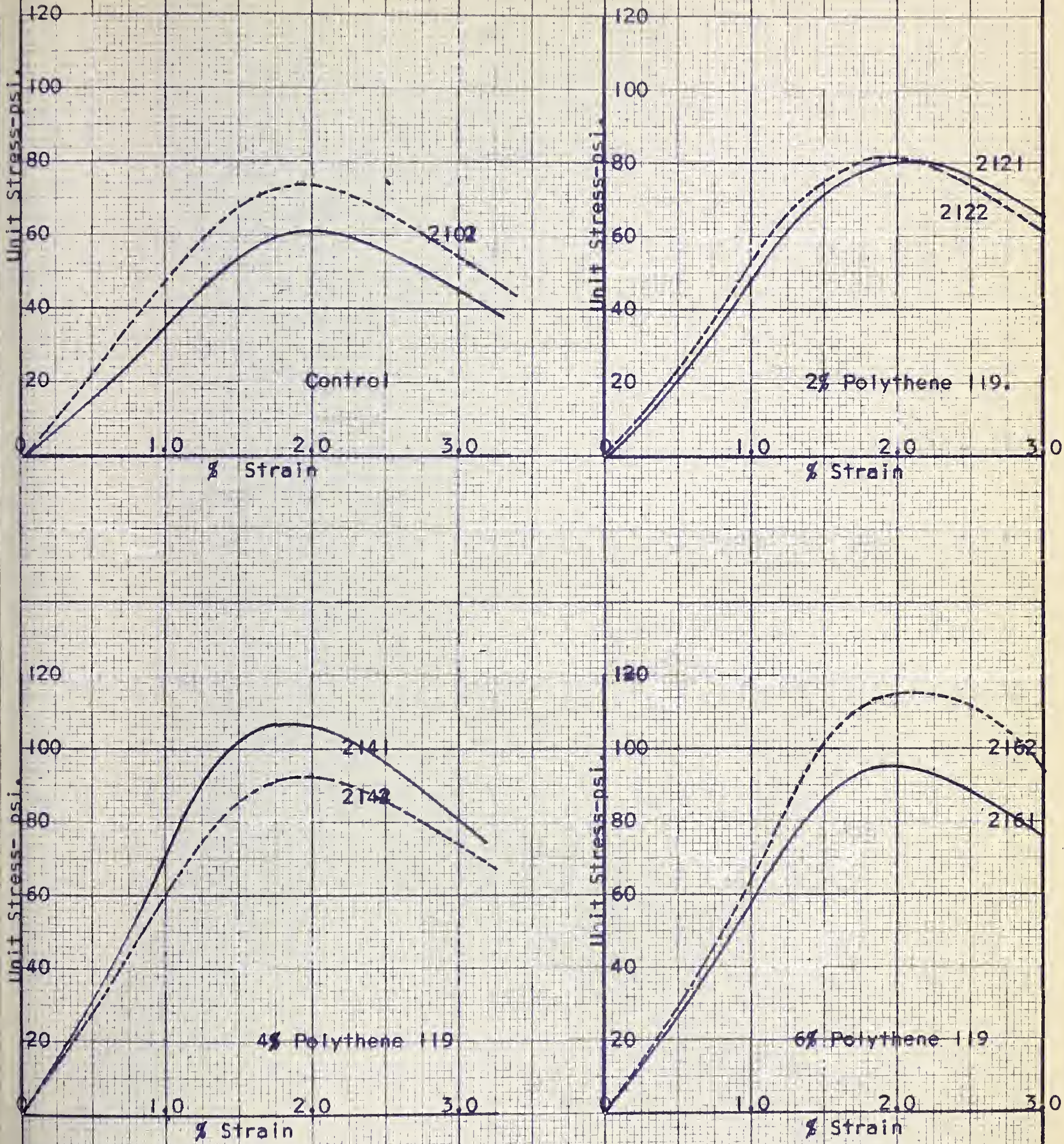
(h) Compute unit stress as total load divided by original cross sectional area.

APPENDIX "C"

STRESS STRAIN CURVES AND EXPERIMENTAL DATA SHEETS.

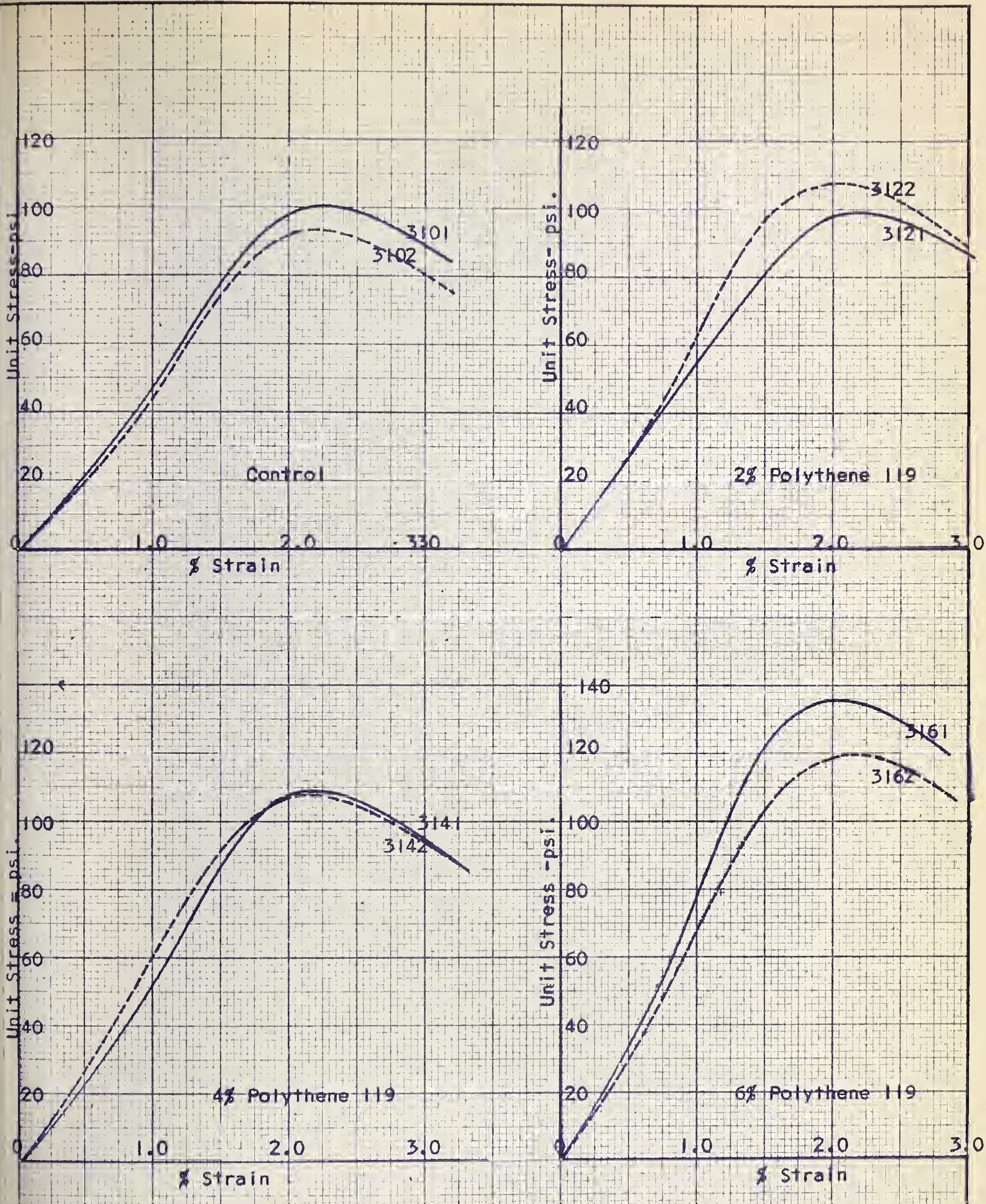


STRESS-STRAIN CURVES FOR 2" DIAMETER COMPRESSION SPECIMENS.
75°F. NO ACCELERATED AGEING.



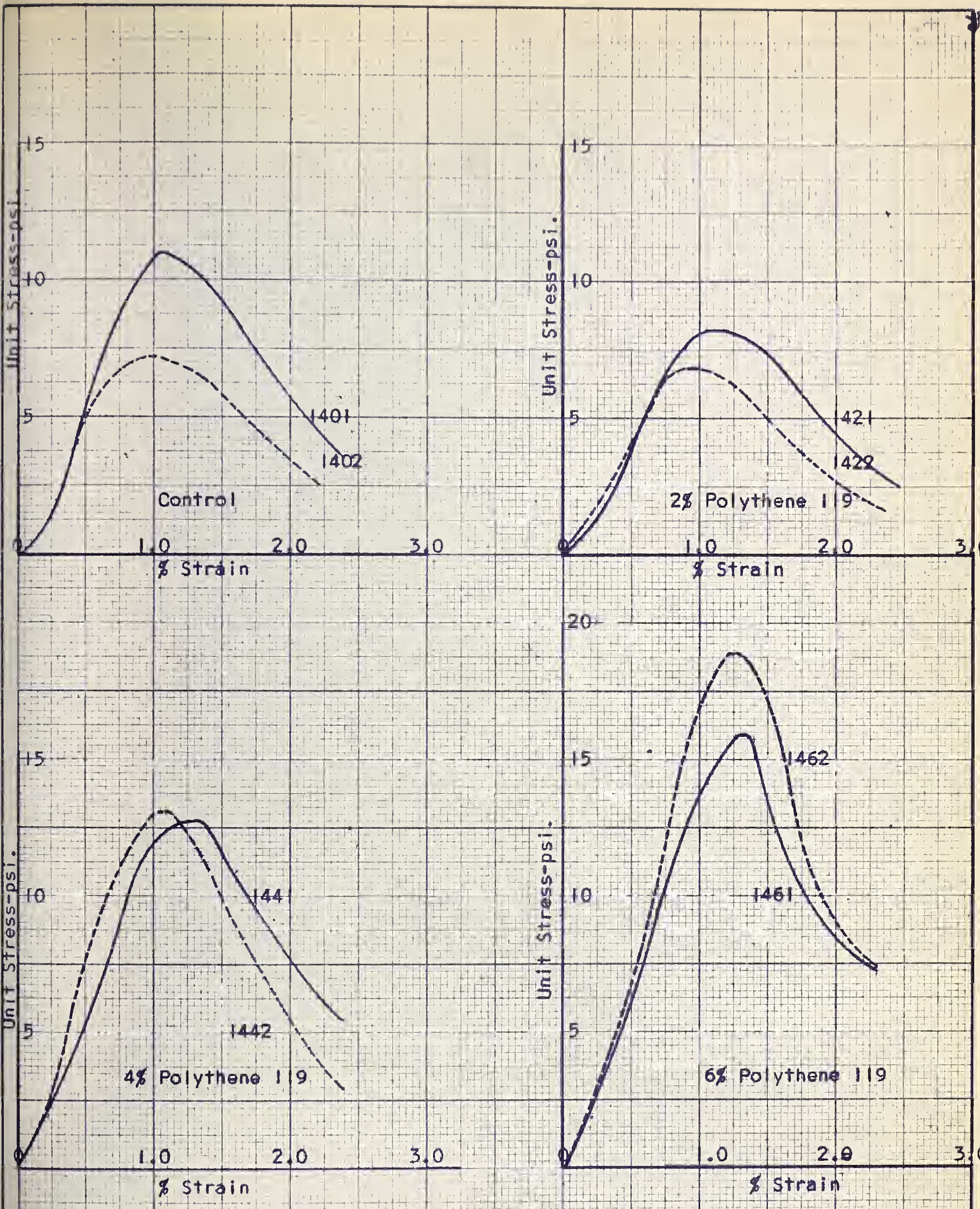
STRESS-STRAIN CURVES FOR 2" DIAMETER COMPRESSION SPECIMENS.
75°F. ACCELERATED AGEING -29 HOURS AT 140°F.

PLATE 29.



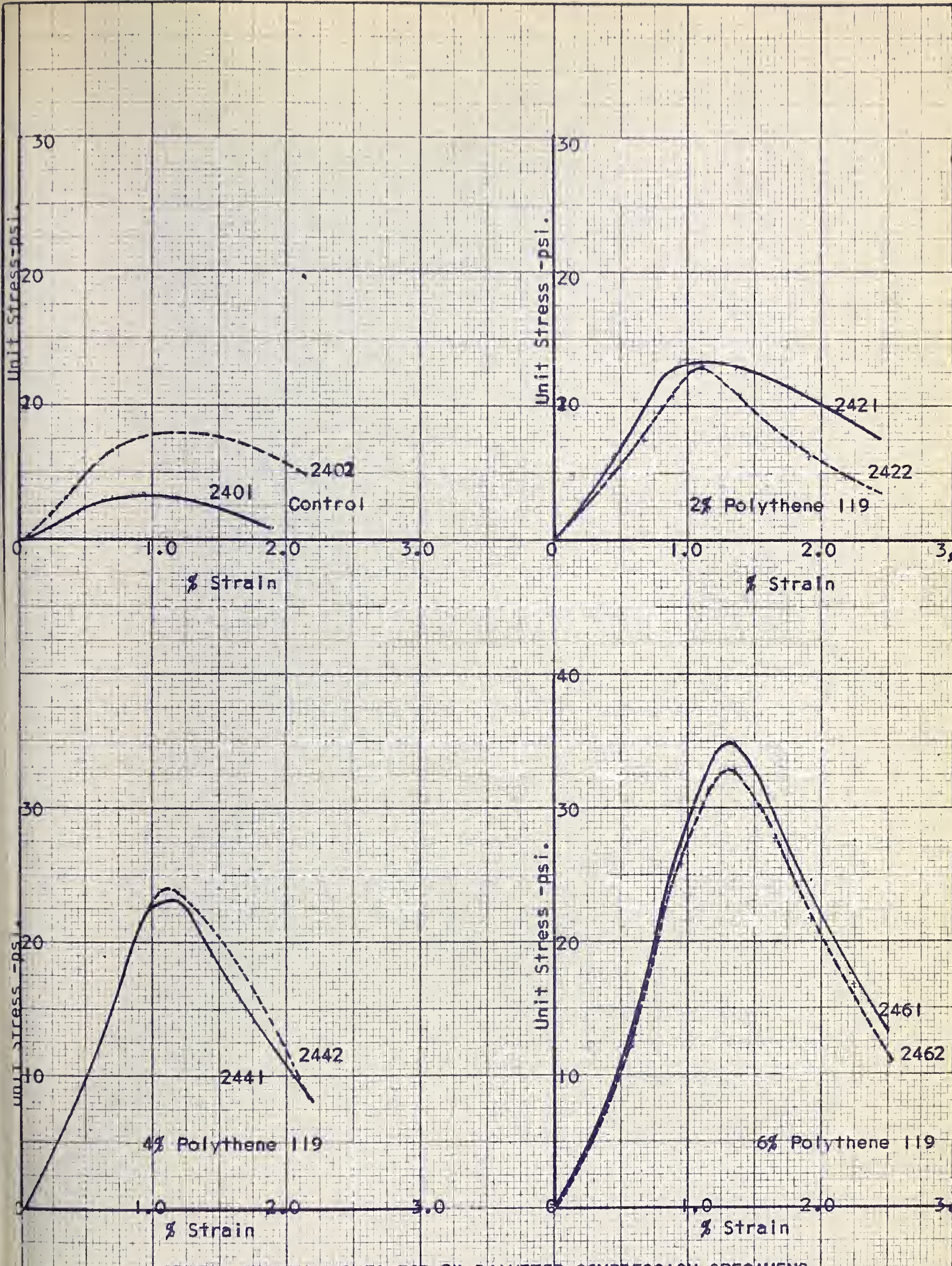
STRESS-STRAIN CURVES FOR 2" DIAMETER COMPRESSION SPECIMENS.
75°F. ACCELERATED AGEING - 70 HOURS AT 140°F.

PLATE 30.

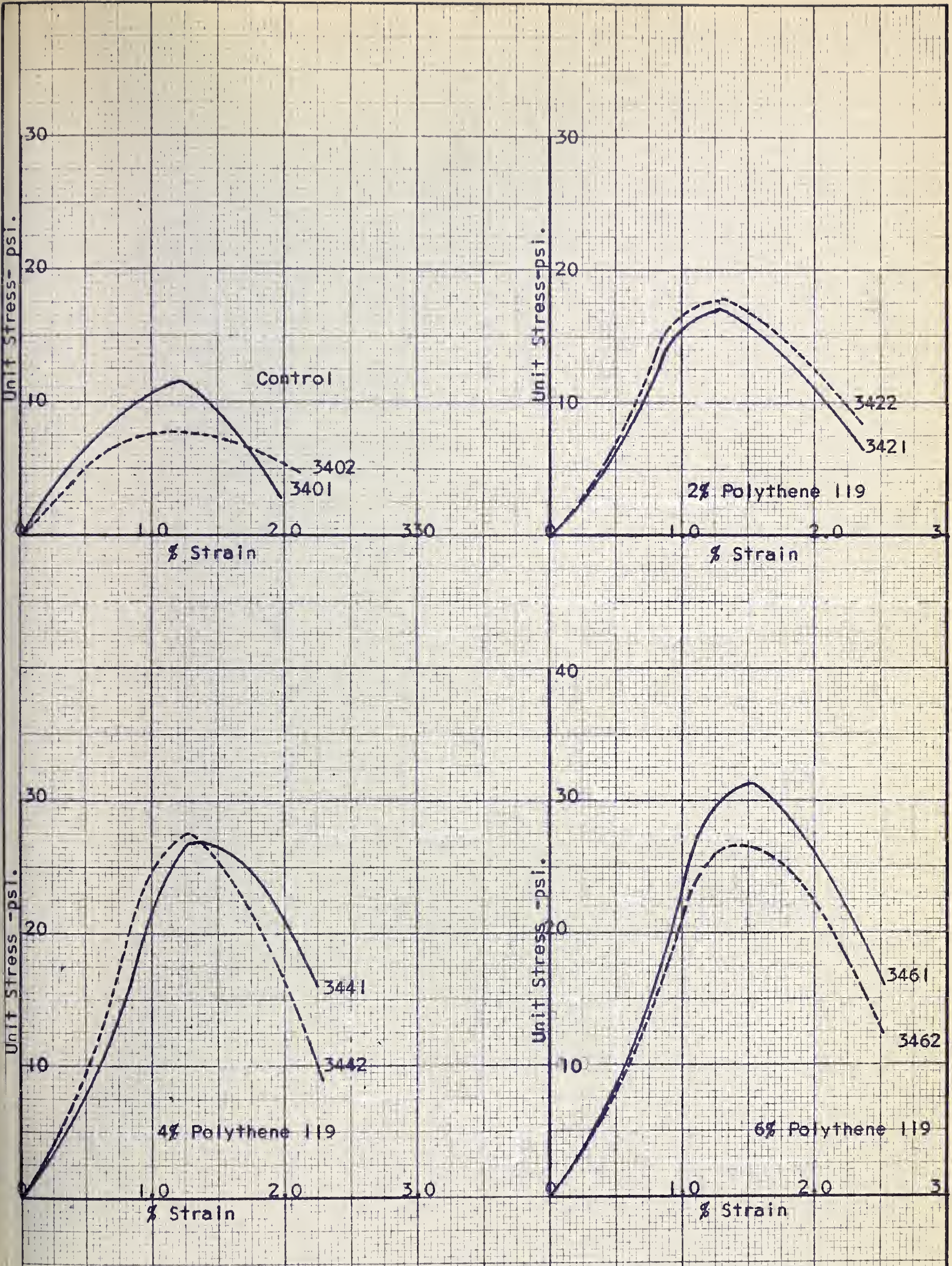


STRESS - STRAIN CURVES FOR 2" DIAMETER COMPRESSION SPECIMENS,
140°F. NO ACCELERATED AGEING.

PLATE 31.

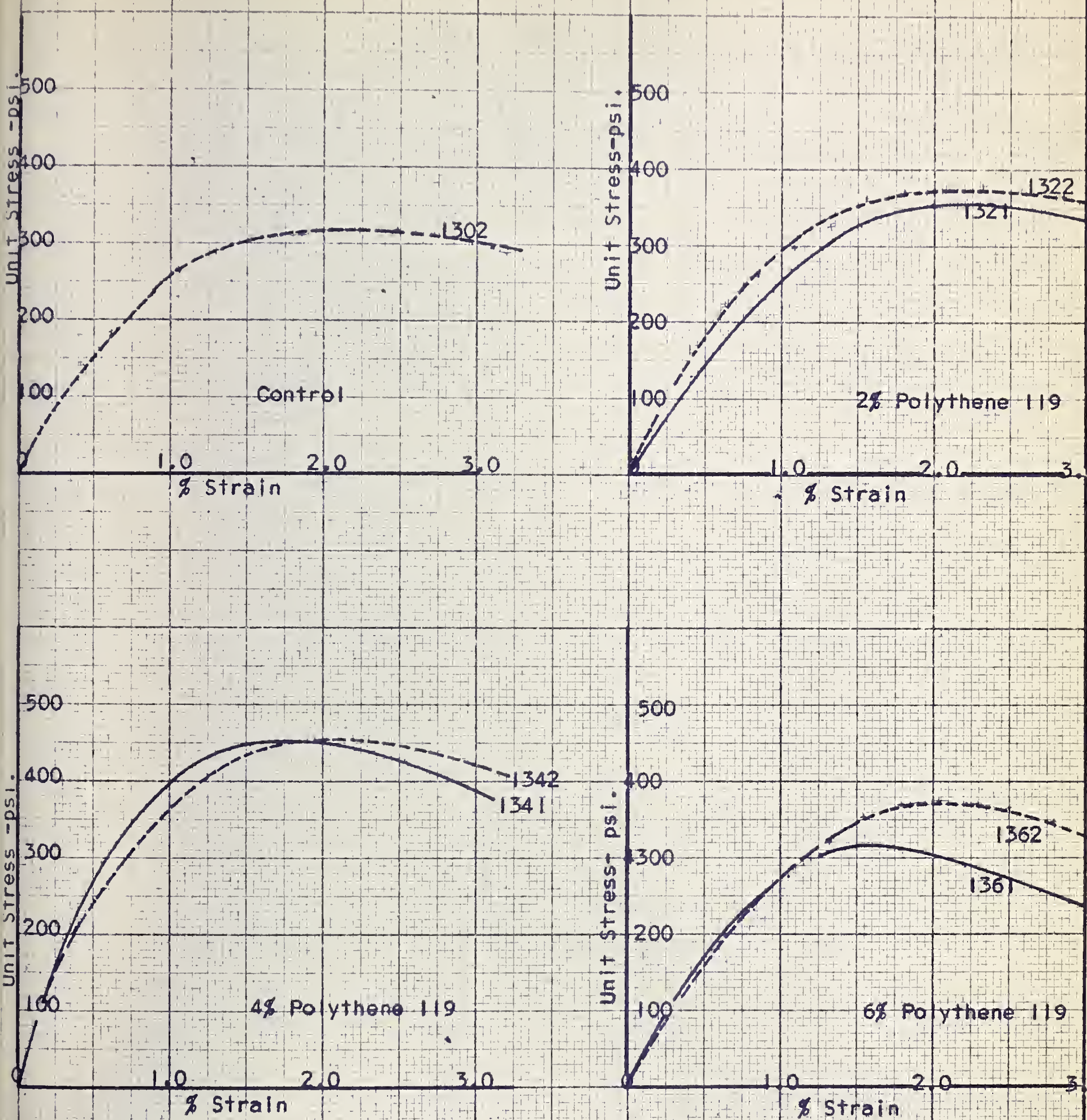


STRESS-STRAIN CURVES FOR 2" DIAMETER COMPRESSION SPECIMENS.
140°F. ACCELERATED AGEING - 29 HOURS AT 140°F.



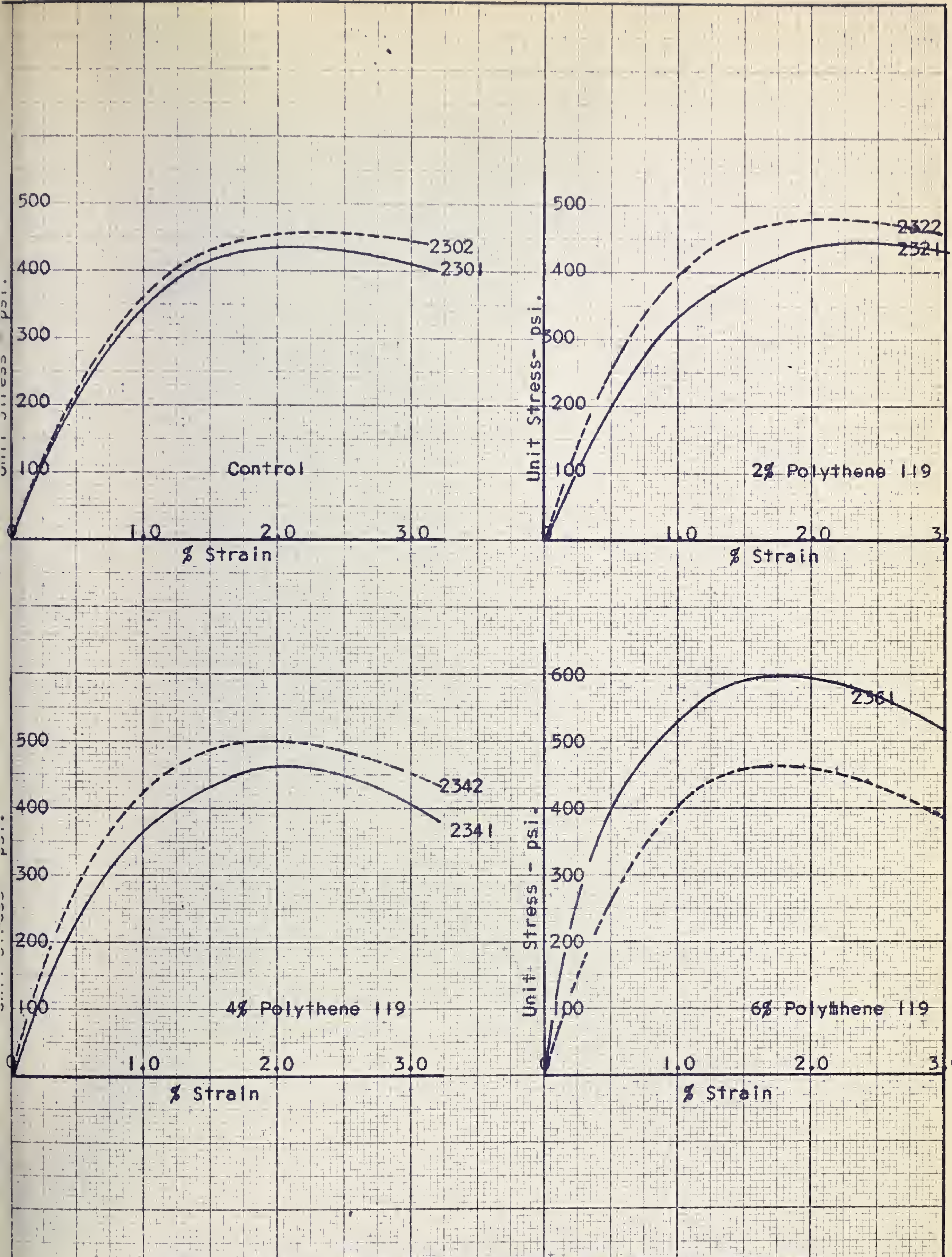
STRESS- STRAIN CURVES FOR 2" DIAMETER COMPRESSION SPECIMENS.
140°F. ACCELERATED AGEING- 70 HOURS AT 140°F.

PLATE 33.



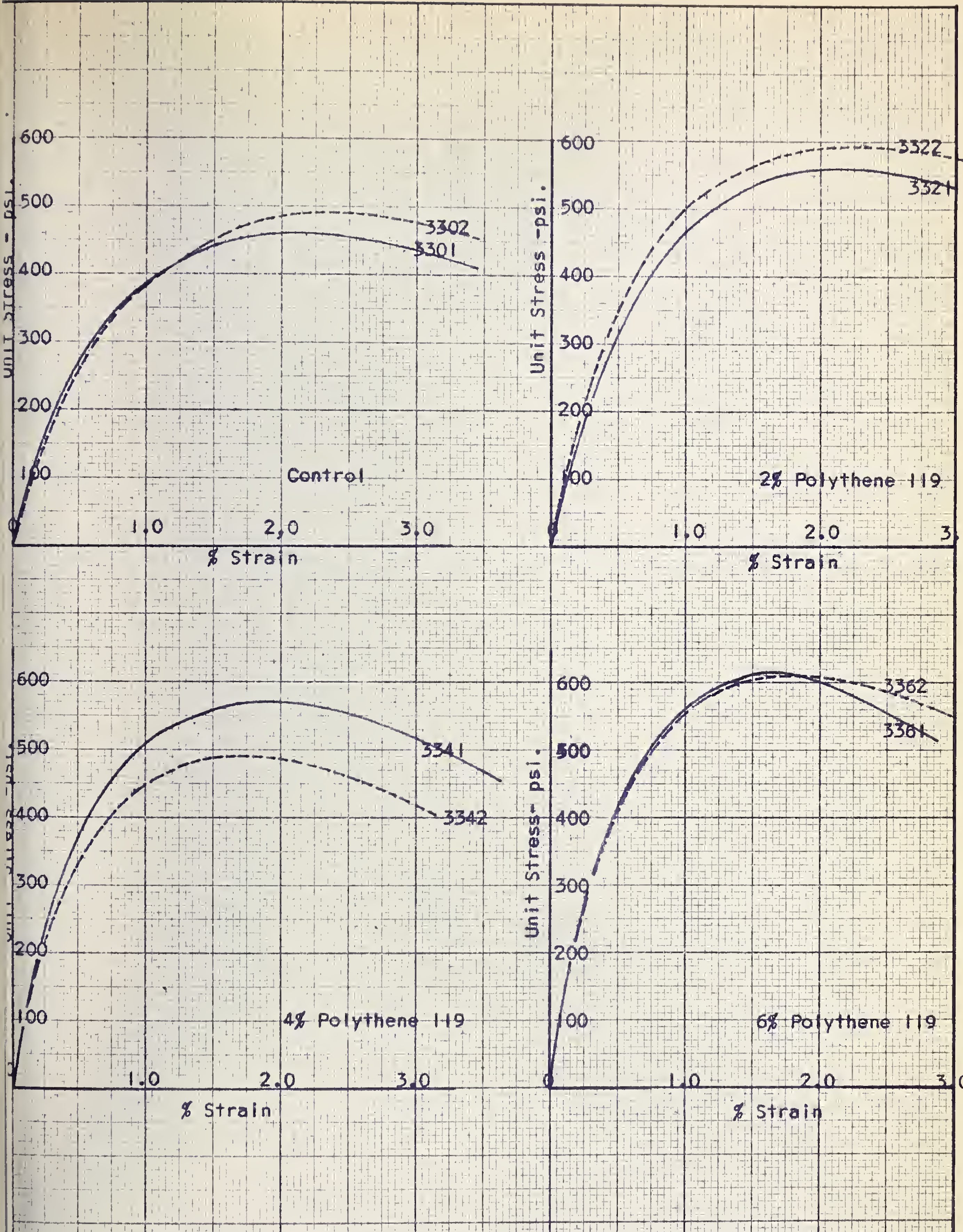
STRESS- STRAIN CURVES FOR 2" DIAMETER COMPRESSION SPECIMENS.
36°F. NO ACCELERATED AGEING.

PLATE 34



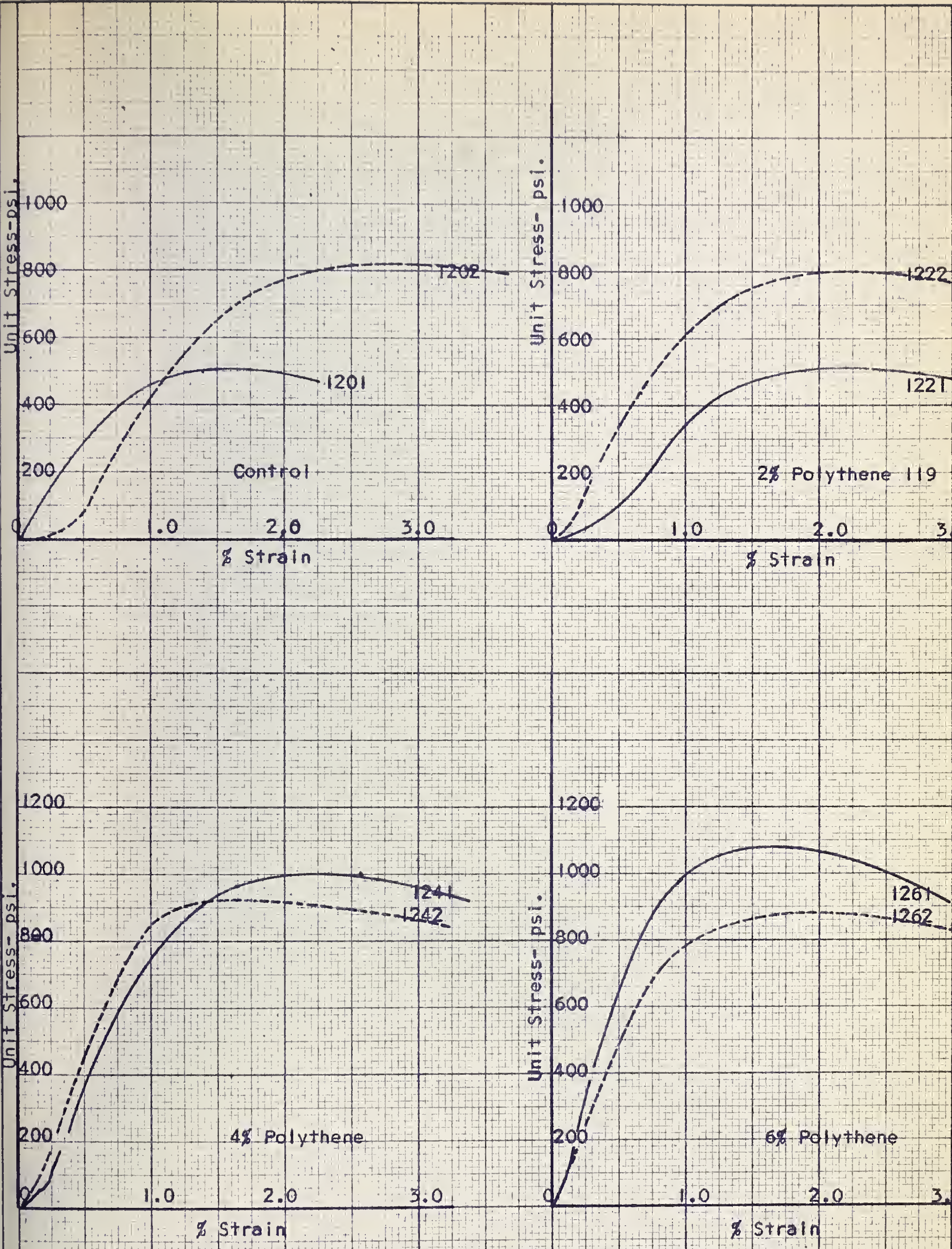
STRESS - STRAIN CURVES FOR 2" DIAMETER COMPRESSION SPECIMENS.
36°F. ACCELERATED AGEING = 29 HOURS AT 140°F.

PLATE 35.

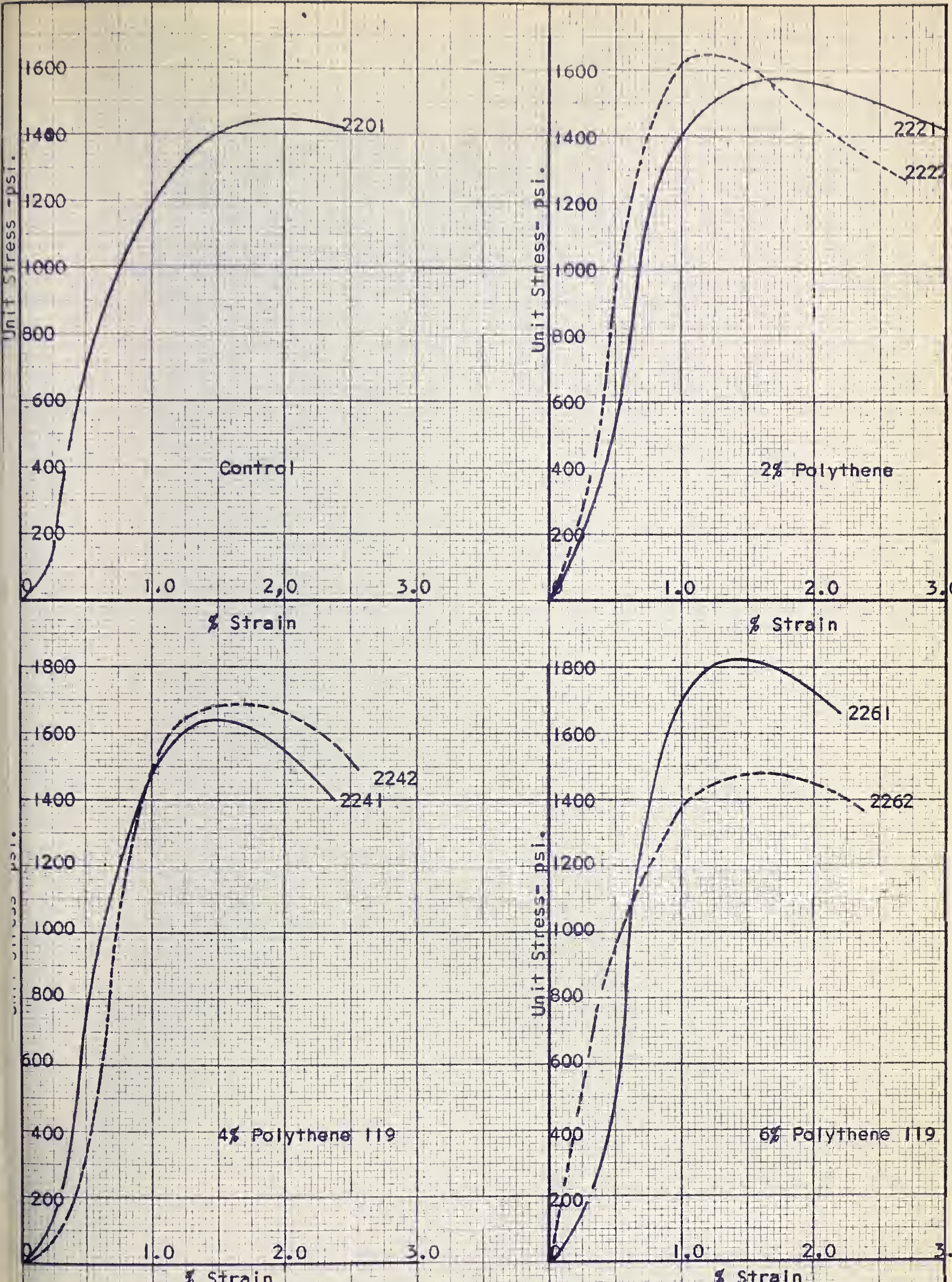


STRESS - STRAIN CURVES FOR 2" DIAMETER COMPRESSION SPECIMENS.
36°F. ACCELERATED AGEING - 70 HOURS AT 140°F.

PLATE 36.

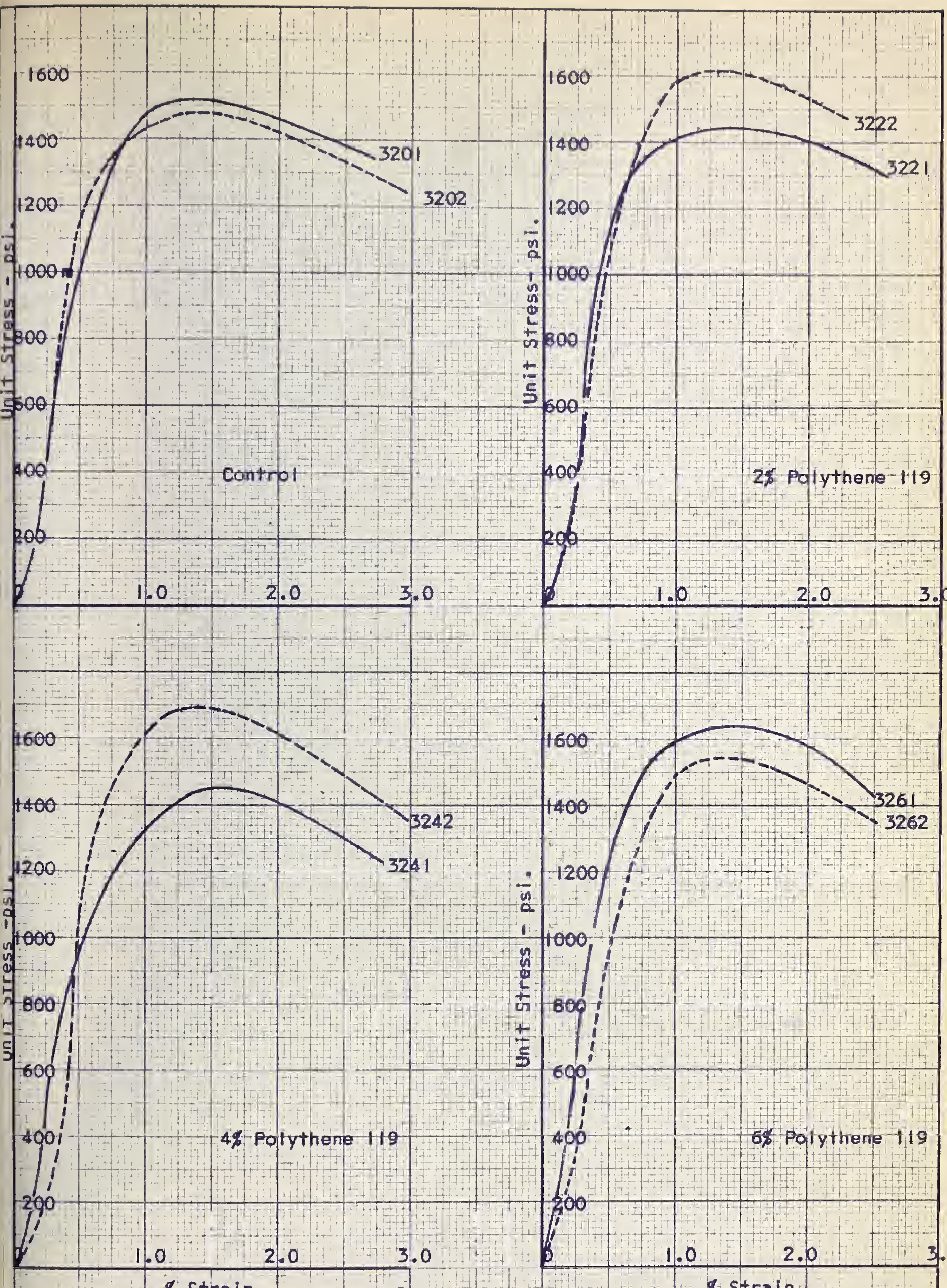


STRESS- STRAIN CURVES FOR 2" DIAMETER COMPRESSION SPECIMENS.
10°F. NO ACCELERATED AGEING.



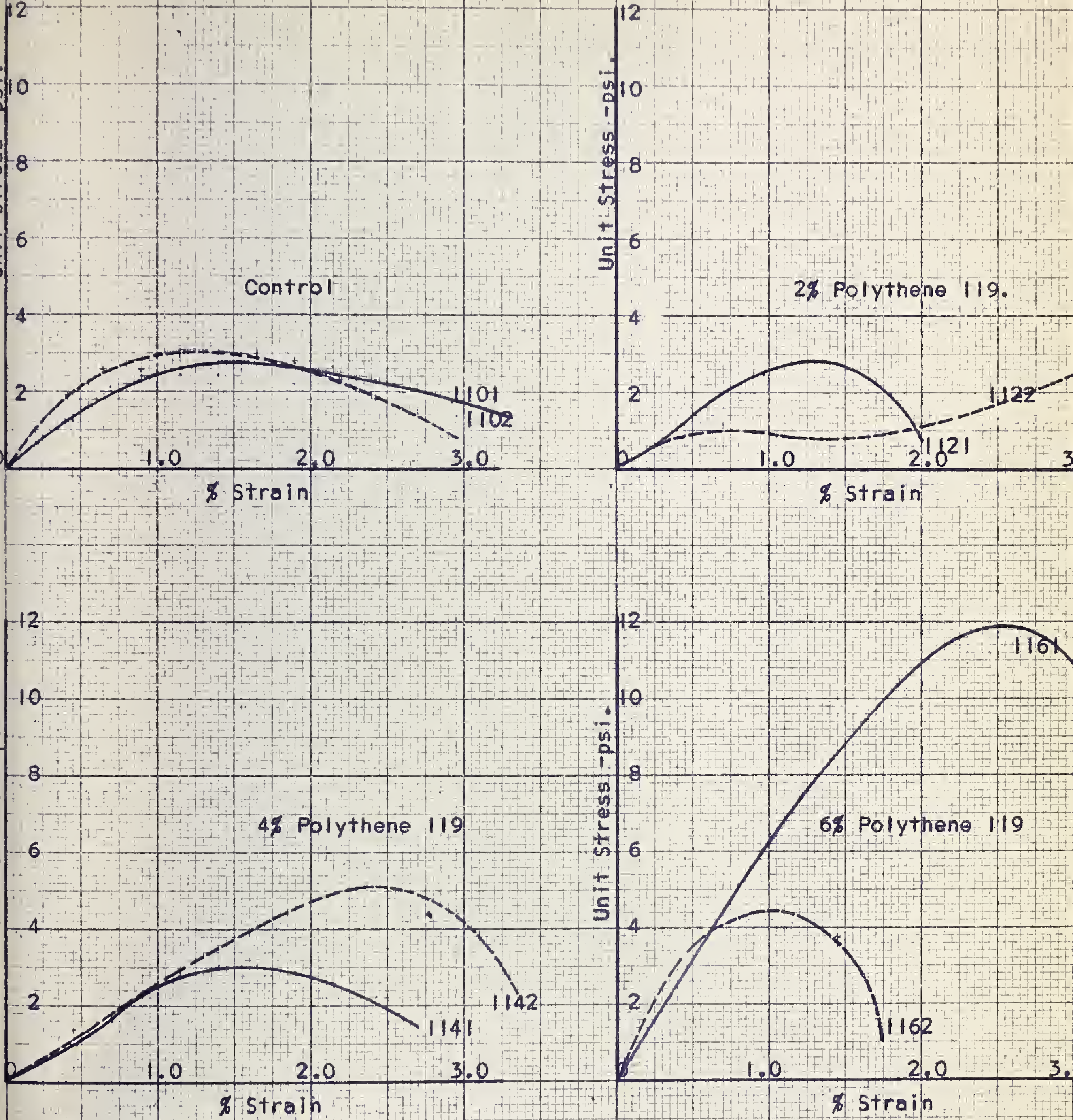
STRESS - STRAIN CURVES FOR 2" DIAMETER COMPRESSION SPECIMENS.
10°F. ACCELERATED AGEING - 29 HOURS AT 140°F.

PLATE 38.



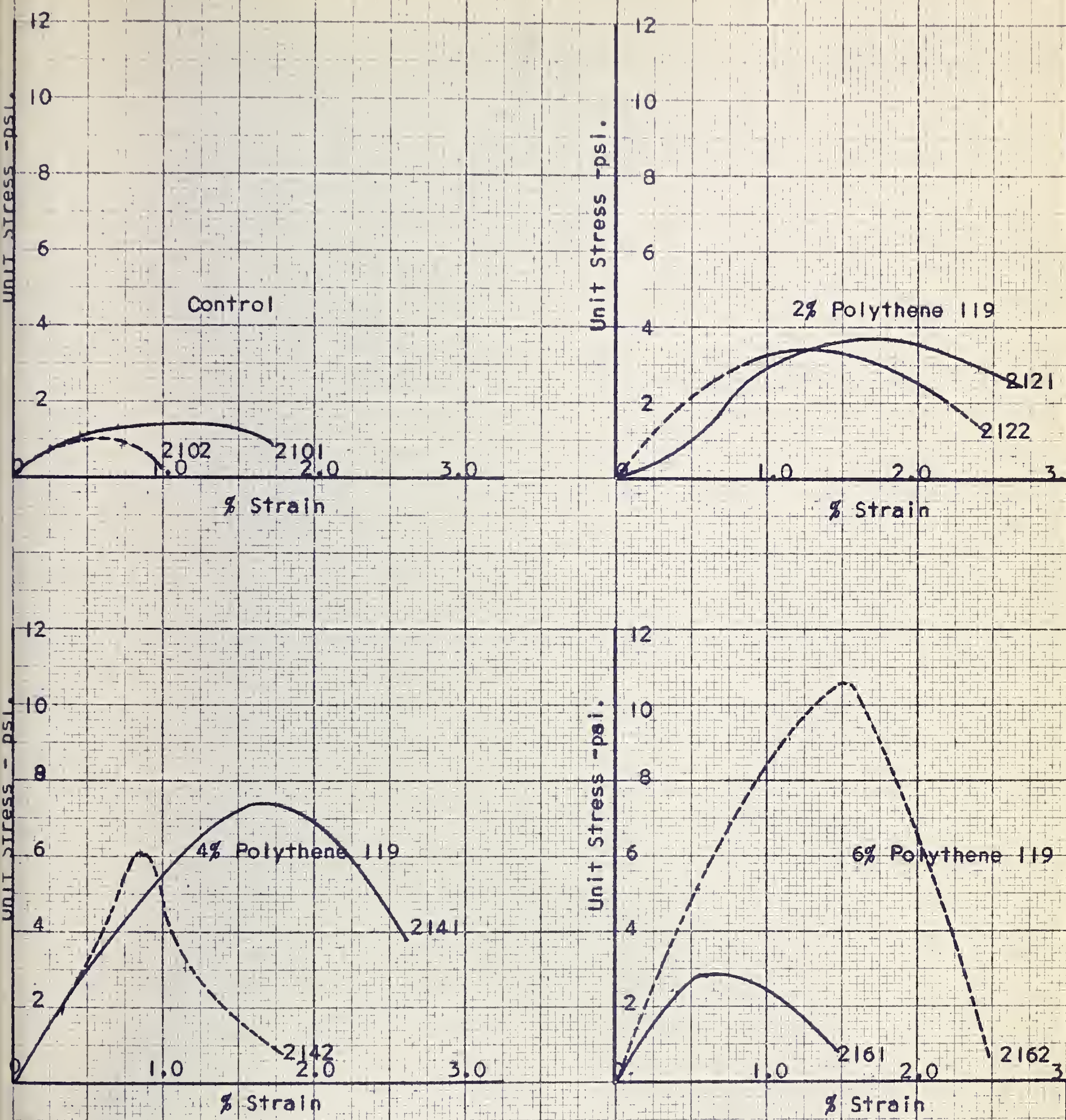
STRESS STRAIN CURVES FOR 2" DIAMETER COMPRESSION SPECIMENS.
10°F. ACCELERATED AGEING - 70 HOURS AT 140°F.

PLATE 39.



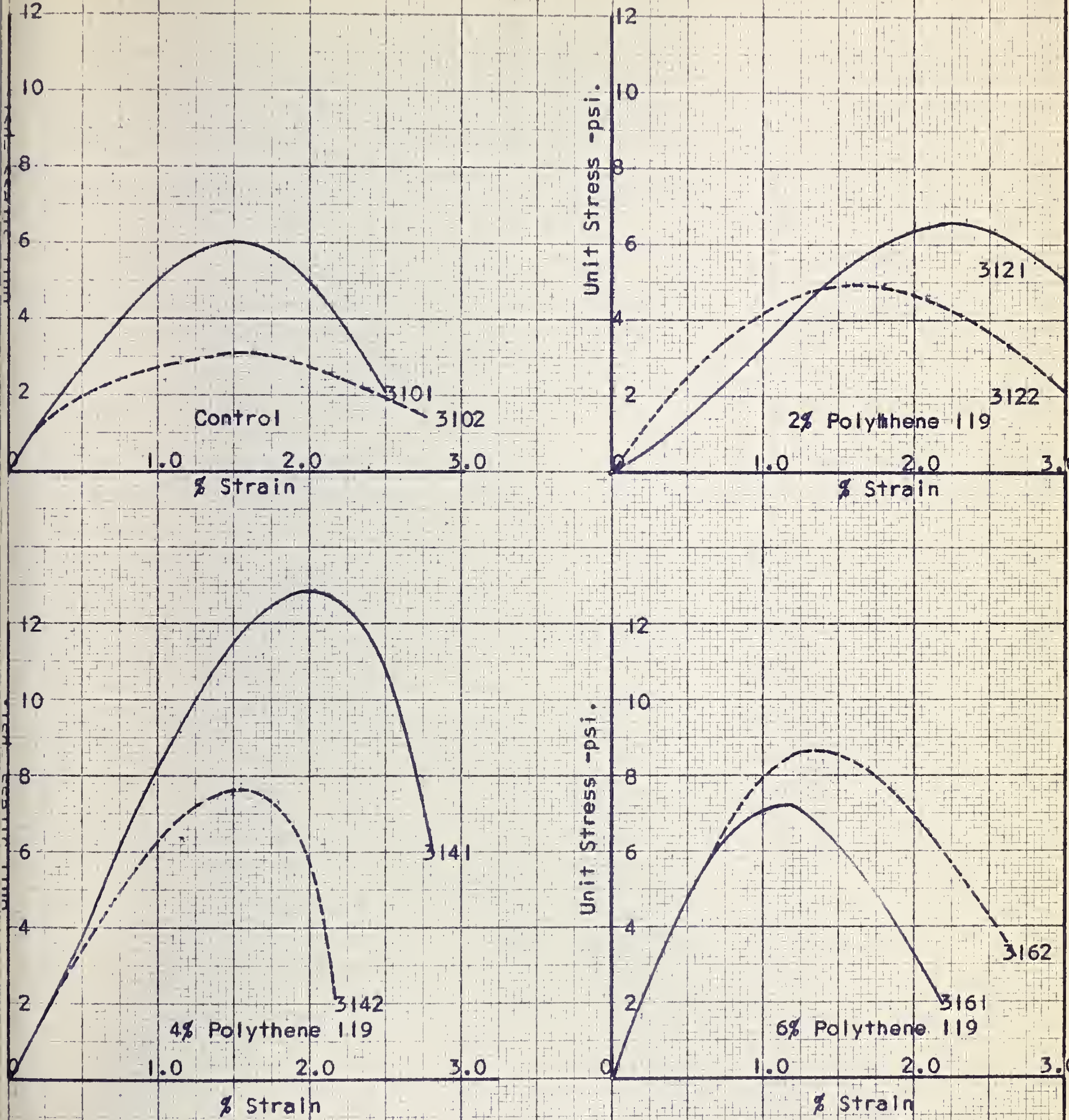
STRESS - STRAIN CURVES FOR 6" TENSION SPECIMENS.
75°F. NO ACCELERATED AGEING.

PLATE 40.



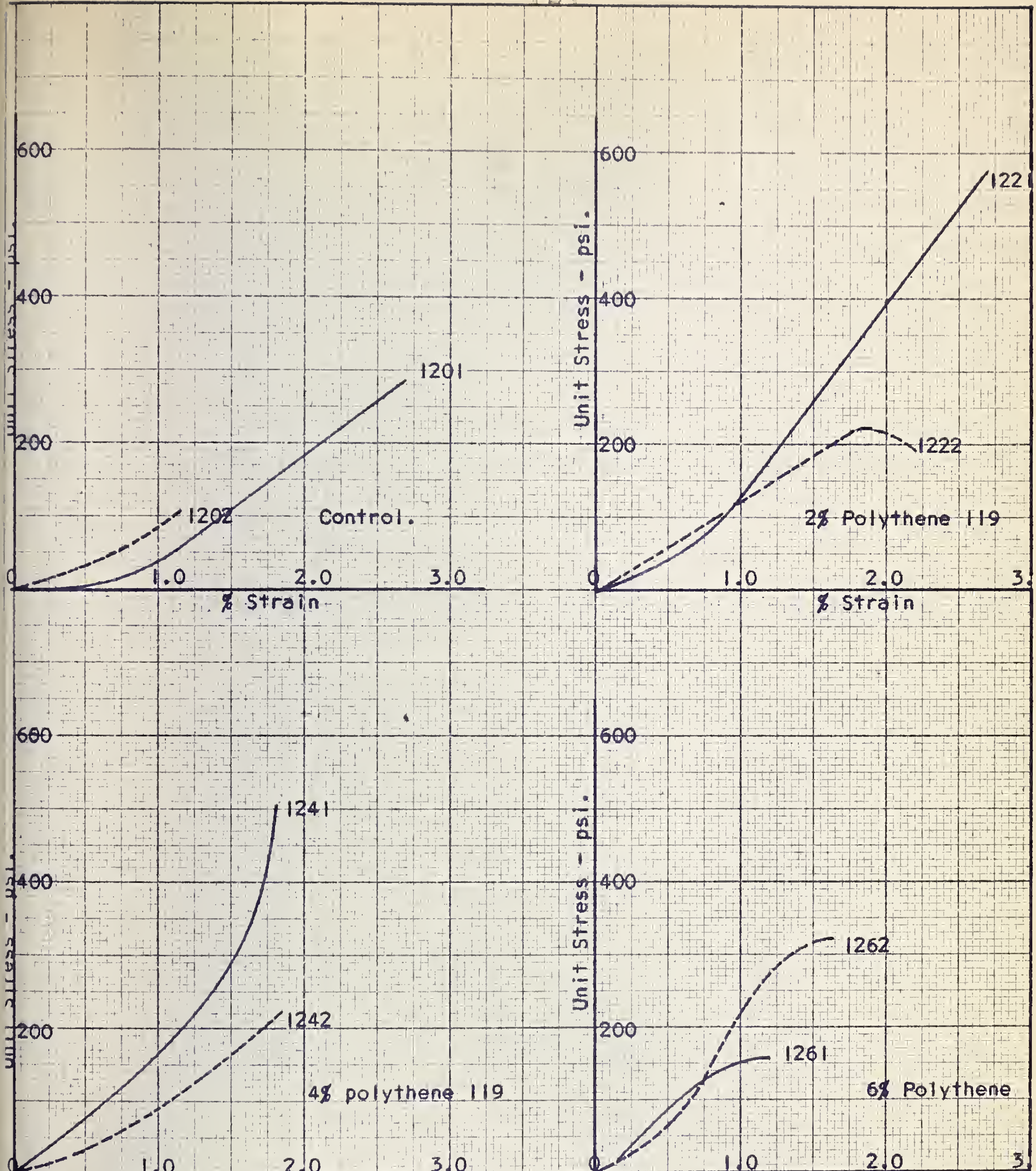
STRESS - STRAIN CURVES FOR 6" TENSION SPECIMENS.
75°F. ACCELERATED AGEING - 29 HOURS AT 140°F.

PLATE 41.



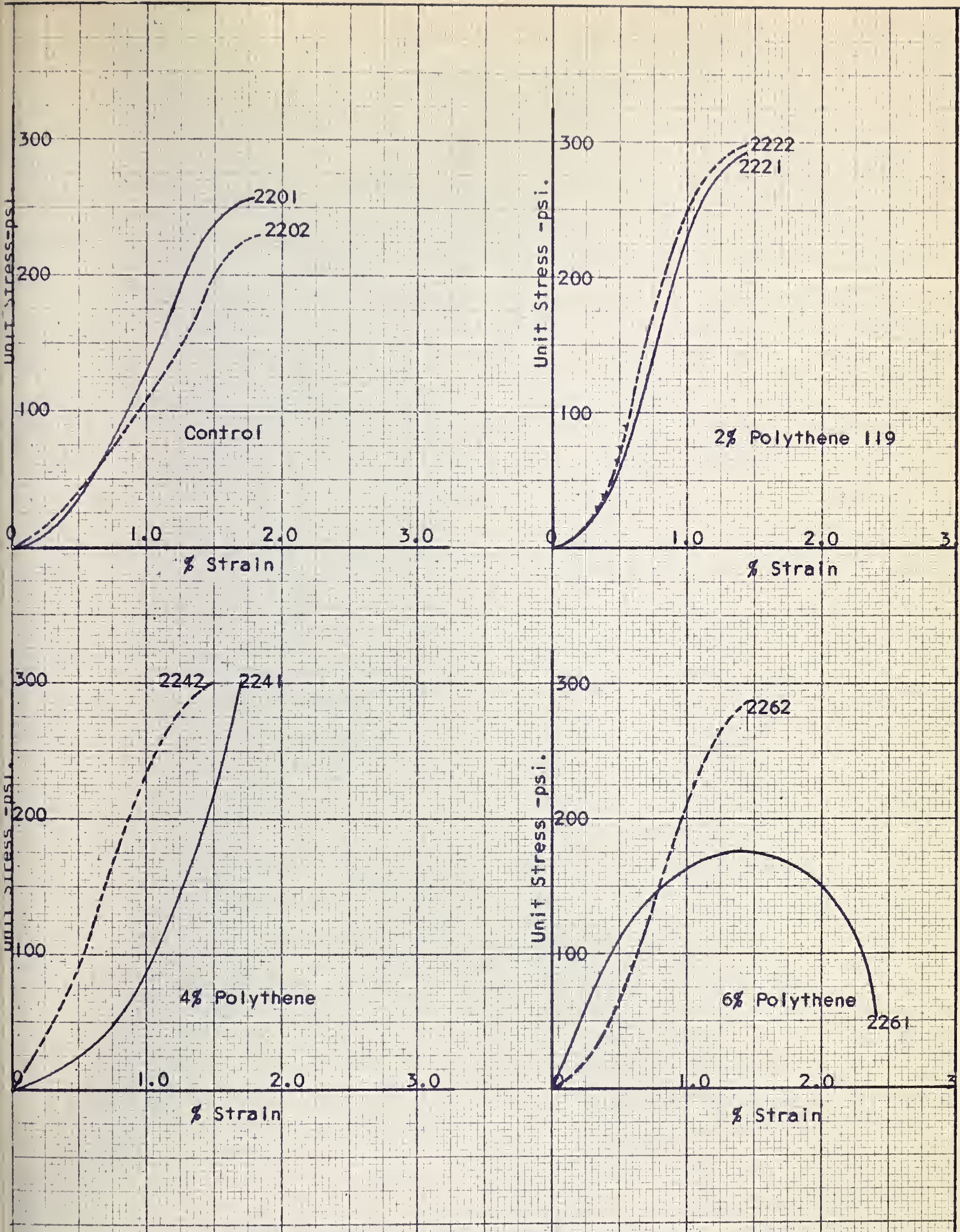
STRESS- STRAIN CURVES FOR 6" TENSION SPECIMENS.
75°F. ACCELERATED AGEING - 70 HOURS AT 140°F.

PLATE 42.



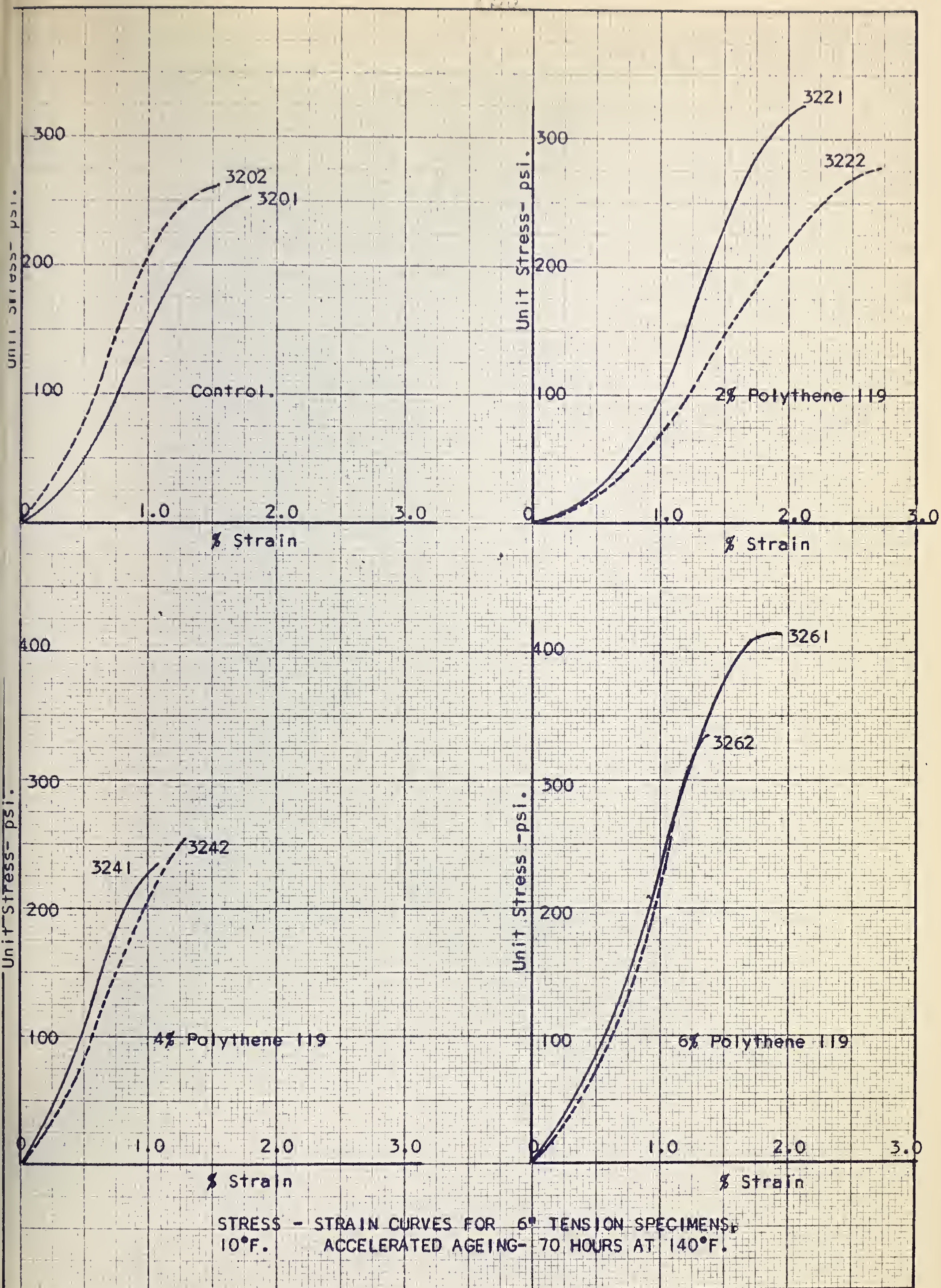
STRESS - STRAIN CURVES FOR 8" TENSION SPECIMENS.
10°F. ACCELERATED AGEING - NONE.

PLATE 43.



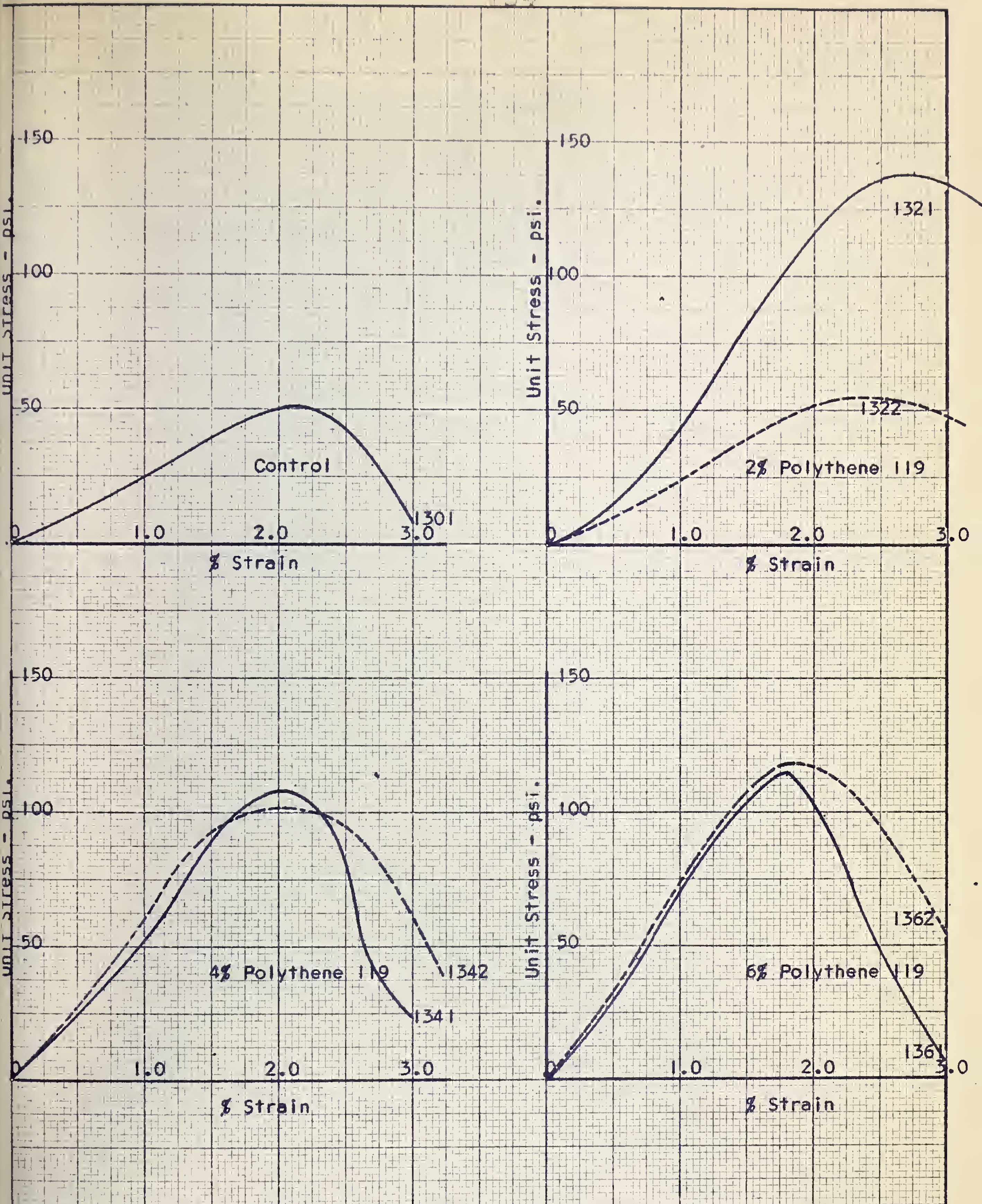
STRESS - STRAIN CURVES FOR 6" TENSION SPECIMENS.
10 °F. ACCELERATED AGEING - 29 HOURS AT 140°F.

PLATE 44.



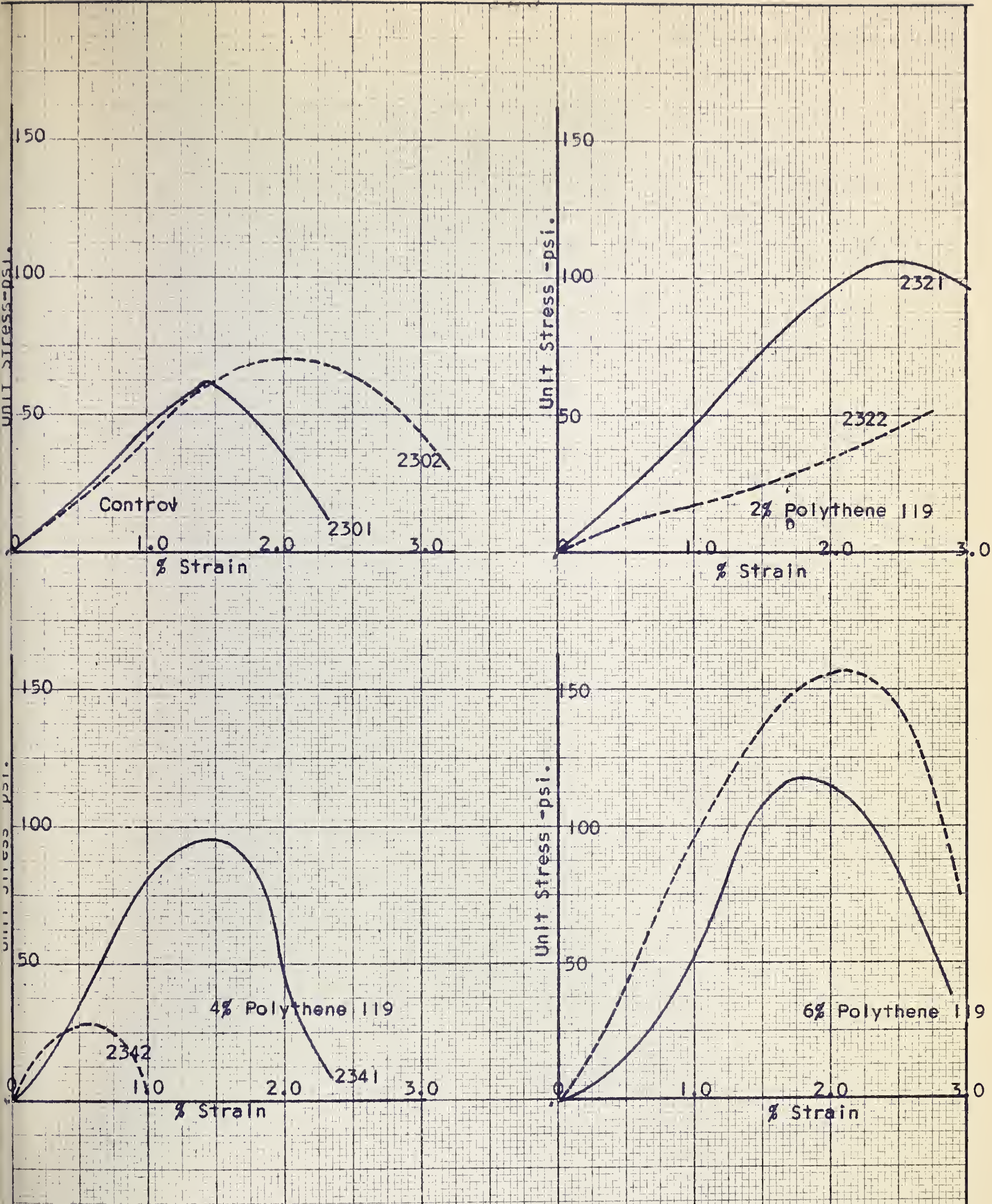
STRESS - STRAIN CURVES FOR 6" TENSION SPECIMENS,
10°F. ACCELERATED AGEING- 70 HOURS AT 140°F.

PLATE 45.



STRESS - STRAIN CURVES FOR 6" TENSION SPECIMENS.
36°F. NO ACCELERATED AGEING.

PLATE 46.



STRESS - STRAIN CURVES FOR 6" TENSION SPECIMENS.
36°F. ACCELERATED AGEING - 29 HOURS AT 140°F.

PLATE 47.

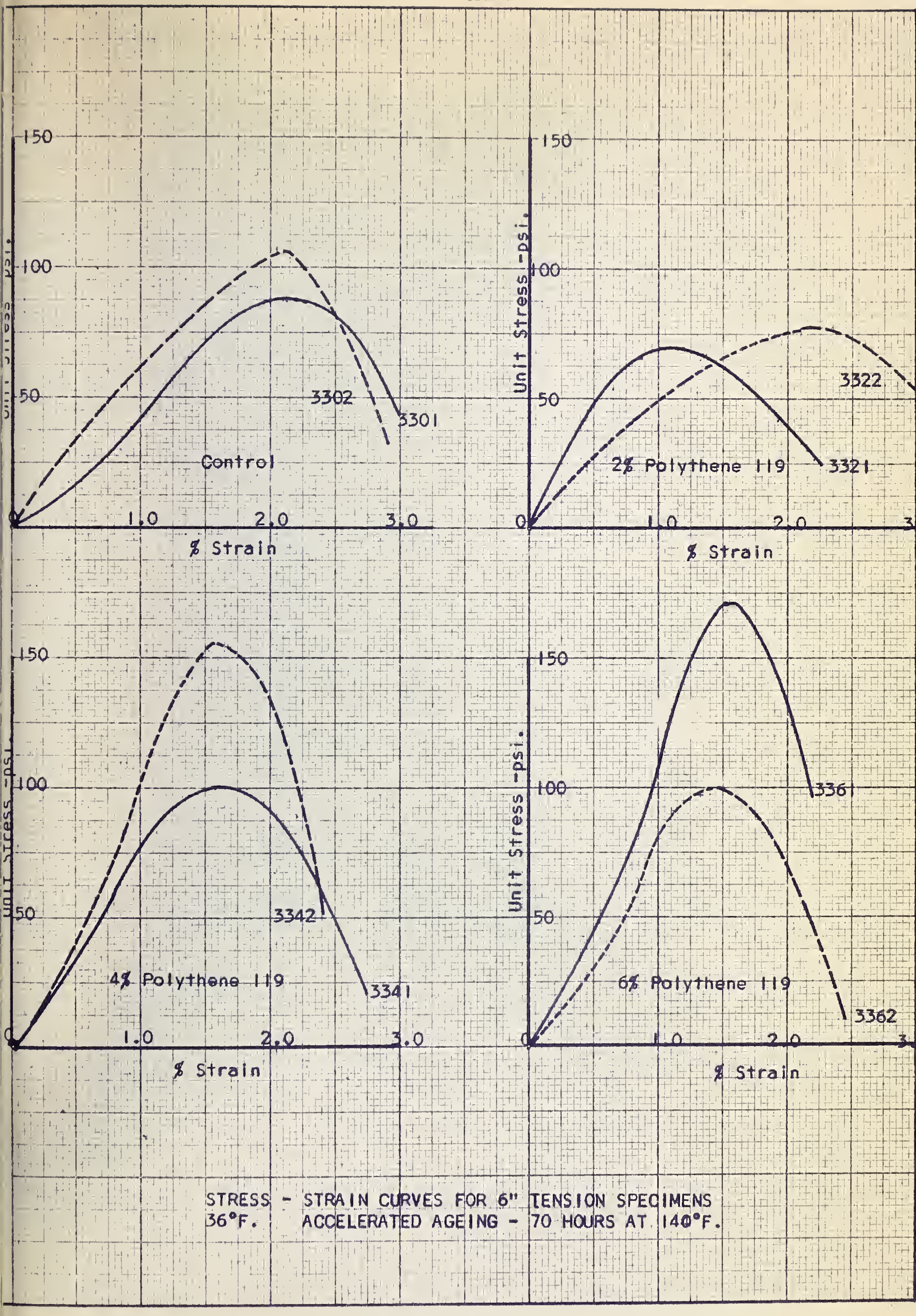

150
100
50
0
Unit Stress -psi.
1.0
2.0
3.0
% Strain
3302
3301
Control
2% Polythene 119
3322
3321
4% Polythene 119
3342
3341
6% Polythene 119
3361
3362
STRESS - STRAIN CURVES FOR 6" TENSION SPECIMENS
36°F. ACCELERATED AGEING - 70 HOURS AT 140°F.

PLATE 48.

University ...

Sheet 1

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Project ______

Code No's. C-110

Technician B.P.S.

Date: February 7/56

Specimen	1101	1102
Test -- Compression	x	x
Length ins.	4.05	4.00
Diameter ins.	2.00	3.00
Volume cc's	208.49	205.92
Unit Weight #/cu.ft	141.65	139.71
Cross-sect. Area sq.ins	3.14	3.14
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.ins		
Unit Weight #/cu.ft		
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	Polythene 119Comm
Date Fabricated	January 18/56
Date Tested	February 7/56
Testing Temperature	75 °F
Accelerated Aging:	0 hrs. @ °F
Rate of Strain	0.08 in/min.
Proving Ring	400 #Cap.

#1101

0.0000

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
	0.00				
.0019	0.01	.0081	.20	16	5.1
.0041	0.02	.016	.39	32	10.2
.0066	0.03	.023	.57	52	16.4
.0095	0.04	.031	.76	78	24.6
.0125	0.05	.038	.94	101	31.9
.0162	0.06	.044	1.09	131	41.3
.0198	0.07	.050	1.22	162	51.0
.0233	0.08	.957	1.41	188	57.0
.0273	0.09	.063	1.56	221	69.4
.0300	0.10	.070	1.73	243	76.1
.0200	0.11	.079	1.95	248	77.4
.0210	0.12	.089	2.20	250	77.9
.0298	0.13	.100	2.47	241	74.7
.0250	0.14	.115	2.84	202	62.5
	0.15				
.0200	0.16	.140	3.46	162	49.8
	0.17				
.0170	0.18	.163	4.03	138	42.2
.0145	0.19	.176	4.34	118	36.0
.0120	0.20	.188	4.64	98	29.8
.0103	0.21	.197	4.87	81	245
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

#1102

0.0000

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
	0.00				
.0020	0.01	.0098	.25	16	5.1
.0045	0.02	.0165	.41	36	11.4
.0070	0.03	.023	.57	57	18.0
.0098	0.04	.032	.80	80	25.3
.0132	0.05	.037	.92	107	33.8
.0165	0.06	.043	1.07	134	42.2
.0200	0.07	.050	1.25	162	51.0
.0233	0.08	.057	1.43	188	58.9
.0264	0.09	.064	1.60	214	67.1
.0288	0.10	.071	1.77	233	72.9
.0304	0.11	.080	2.00	245	76.4
.0305	0.12	.090	2.25	246	76.6
.0294	0.13	.101	2.52	238	73.8
.0273	0.14	.113	2.82	222	68.7
.0242	0.15	.126	3.14	196	60.4
.0215	0.16	.139	3.48	174	53.3
.0188	0.17	.152	3.80	753	46.8
.0160	0.18	.164	4.10	130	39.7
.0135	0.19	.177	4,43	110	33.4
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 2

Project

Code No's: C-112

Technician B.P.S.

Date: February 7/56

Specimen	1121	1122
Test -- Compression	x	x
Length ins.	4.09	4.12
Diameter ins.	2.0	2.00
Volume cc's	210.55	212.10
Unit Weight #/cu.ft.	139.0	138.47
Cross-sect. Area sq.ins.	3.14	3.14
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.ins.		
Unit Weight #/cu.ft.		
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Huskey Pen 200-300
% Additive	2.0
Type Additive	Polythene 119Comm
Date Fabricated	January 19/56
Date Tested	February 7/56
Testing Temperature	75 °F
Accelerated Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	400 #Cap.

0.0000

1121

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0032	0.01	.0097	.24	25	7.95
.0059	0.02	.015	.37	48	15.2
.0086	0.03	.021	.51	70	22.2
.0113	0.04	.029	.71	93	29.4
.0144	0.05	.036	.88	108	34.1
.0179	0.06	.042	1.03	146	46.0
.0211	0.07	.049	1.20	171	53.8
.0242	0.08	.056	1.37	196	61.5
.0273	0.09	.063	1.54	221	69.4
.0294	0.10	.071	1.74	239	74.9
.0300	0.11	.080	1.96	243	75.8
.0297	0.12	.090	2.20	241	85.1
.0278	0.13	.103	2.52	226	70.2
.0251	0.14	.115	2.82	203	
.0222	0.15	.128	3.14	181	
.0191	0.16	.141	3.45	254	
.0163	0.17	.154	3.77	132	
.0137	0.18	.167	4.08	111	
.0114	0.19	.179	4.38	92	
.0100	0.20	.190	4.64	81	
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1122

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
	0.00				
.0026	0.01	.0097	.24	21	6.7
.0047	0.02	.016	.36	21	12.4
.0070	0.03	.023	.53	57	18.1
.0098	0.04	.030	.70	80	25.3
.0128	0.05	.038	.87	104	32.8
.0155	0.06	.045	1.09	126	39.7
.0190	0.07	.051	1.24	154	48.4
.0223	0.08	0058	1.41	181	56.9
.0250	0.09	.065	1.58	202	63.3
.0272	0.10	.073	1.77	221	69.2
.0282	0.11	.083	2.04	229	71.6
.0280	0.12	.092	2.34	227	70.7
.0267	0.13	.104	2.52	218	67.7
.0243	0.14	.116	2.82	197	61.0
.0213	0.15	.129	3.13		
.0185	0.16	.142	3.45		
.0155	0.17	.155	3.76		
.0125	0.18	.168	4.08		
.0110	0.19	.179	4.34		
.0092	0.20	.191	4.64		
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

University of Alberta

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 3

Project

Code No's. C-114

Technician B.P.S.

Date: February 7/56

Specimen	1141	1142
Test -- Compression	x	x
Length ins.		
Diameter ins.	4.12	4.16
Volume cc's	213.0	214.2
Unit Weight #/cu.ft	140.7	142.5
Cross-sect. Area sq.ins.	3.14	3.14
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.ins.		
Unit Weight #/cu.ft.		
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen.200-300
% Additive	4.0
Type Additive	Polythene119Comm
Date Fabricated	January 21/56
Date Tested	February 7/56
Testing Temperature	75 °F
Accelerated Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	400 #Cap.

1141

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0022	0.01	.0098	.24	18	5.7
.0053	0.02	0.015	.36	43	13.6
.0078	0.03	.022	.53	63	20.0
.0110	0.04	.029	.70	89	28.1
.0146	0.05	.036	.87	119	37.6
.0185	0.06	.042	1.02	150	47.3
.0228	0.07	.048	1.16	185	58.3
.0275	0.08	.053	1.29	223	70.0
.0315	0.09	.059	1.43	255	80.0
.0349	0.10	.066	1.60	283	88.6
.0365	0.11	.074	1.80	296	92.5
.0365	0.12	.084	2.04	296	92.3
.0340	0.13	.096	2.34	276	85.8
.0302	0.14	.110	2.67	242	74.9
.0251	0.15	.125	3.04	210	
.0202	0.16	.140	3.40	164	
.0170	0.17	.153	3.72	138	
.0140	0.18	.166	4.03	114	
.0111	0.19	.179	4.35	89	
.0098	0.20	.190	4.61	80	
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1142

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0040	0.01	.0096	.23	32	10.2
.0069	0.02	.013	.31	57	18.1
.0104	0.03	.020	.48	85	26.9
.0141	0.04	.026	.62	114	36.1
.0184	0.05	.032	.77	149	47.3
.0225	0.06	.038	.91	182	57.4
.0272	0.07	.043	1.06	221	69.6
.0315	0.08	.049	1.18	253	79.6
.0360	0.09	.054	1.30	291	91.6
.0400	0.10	.060	1.44	322	101.0
.0423	0.11	.068	1.63	342	107.0
.0425	0.12	.078	1.87	344	107.0
.0408	0.13	.089	2.14	331	103.2
.0370	0.14	.103	2.48	297	92.0
.0312	0.15	.119	2.86	254	
.0260	0.16	.124	3.00		
.0219	0.17	.148			
.081	0.18	.162			
.0151	0.19	.175			
.0130	0.20	.187			
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

Sheet 4

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Project

Code No's. C-116

Technician B.P.S.

Date: February 7/56

Specimen	1161	1162
Test -- Compression	x	x
Length ins.	4.18	4.06
Diameter ins.	2.00	2.00
Volume cc's	215.2	209.0
Unit Weight #/cu.ft.	135.5	137.6
Cross-sect. Area sq.ins	3.14	3.14
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.ins.		
Unit Weight #/cu.ft.		
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky-Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	January 23/56
Date Tested	February 7/56
Testing Temperature	75 °F
Accelerated Aging:	0 hrs. @ °F
Rate of Strain	0.08 in/min.
Proving Ring	400 #Cap.

1161

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0034	0.01	.010	.24	28	8.9
.0063	0.02	.014	.33	50	15.9
.0093	0.03	.021	.50	75	23.8
.0127	0.04	.030	.72	102	32.2
.0163	0.05	.034	.80	132	41.7
.0200	0.06	.040	.90	162	51.1
.0239	0.07	.046	1.1	194	61.1
.0275	0.08	.052	1.24	223	70.2
.0302	0.09	.0608	1.45	244	76.5
.0308	0.10	.0702	1.68	250	78.4
.0300	0.11	.080	1.91	242	78.0
.0270	0.12	.093	2.20	219	68.3
.0232	0.13	.110	2.50	189	58.7
.0200	0.14	.120	3.00		
.0170	0.15	.133	3.15		
.0143	0.16	.146	3.50		
.0122	0.17	.158	3.80		
.0108	0.18	.169	4.04		
.0092	0.19	.180	4.30		
.0079	0.20	.192	4.59		
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1162

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0023	0.01	.01	.24	19	6.0
.0048	0.02	.019	.47	39	12.4
.0077	0.03	.023	.57	62	19.6
.0108	0.04	.030	.74	87	27.5
.0144	0.05	.036	.89	118	37.2
.0183	0.06	.042	1.03	149	46.9
.0225	0.07	.048	1.18	182	57.2
.0264	0.08	.054	1.33	214	67.2
.0302	0.09	.060	1.48	244	75.5
.0333	0.10	.067	1.65	268	83.8
.0347	0.11	.076	1.87	281	87.8
.0344	0.12	.086	2.12	279	85.9
.0321	0.13	.098	2.42	260	80.7
.0283	0.14	.112	2.76	230	71.2
.0245	0.15	.126	3.11		
.0210	0.16	.139	3.42		
.0170	0.17	.153	3.77		
.0145	0.18	.166	4.09		
.0121	0.19	.178	4.38		
.0104	0.20	.190	4.68		
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

Sheet 5

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Project
Core No's. C-120
Technician BPS
Date: February 10/56

Specimen		2101	2102
Test -- Compression		x	x
Length	ins.	4.10	4.20
Diameter	ins.	2.0	2.0
Volume	cc's	211.1	216.2
Unit Weight	#/cu.ft	136.4	140.3
Cross-sect. Area	sq.ins	3.14	3.14
Test -- Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.ins		
Unit Weight	#/cu.ft.		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky-Pen ~~200~~-300
% Additive	0
Type Additive	Polythene 119 Comm
Date Fabricated	January 18/56
Date Tested	February 10/56
Testing Temperature	75 °F
Accelerated Aging:	29 hrs. @140°F
Rate of Strain	0.08 in/min.
Proving Ring	400 #Cap.

#2101

Proving Ring	Def. Dial	True Def.	% Str	Load #	Stress psi
.0000	0.00				
.0021	0.01	.0098	.24	16	5.08
.0041	0.02	.016	.39	33	10.5
.0068	0.03	.023	.56	56	17.7
.0096	0.04	.031	.76	78	24.6
.0123	0.05	.038	.93	100	31.6
.0153	0.06	.045	1.10	124	39.1
.0182	0.07	.052	1.27	148	46.5
.0207	0.08	.059	1.44	168	52.7
.0228	0.09	.067	1.63	185	58.0
.0240	0.10	.076	1.85	195	60.9
.0242	0.11	.086	2.10	197	61.4
.0228	0.12	.098	2.40	185	57.5
.0207	0.13	.109	2.68	168	52.0
.0182	0.14	.122	2.96	148	45.7
.0152	0.15	.135	3.30	124	38.1
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

#2102

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0032	0.01	.0097	.23	26	8.2
.0059	0.02	.014	.33	48	15.2
.0088	0.03	.021	.50	72	22.8
.0118	0.04	.028	.67	96	30.3
.0153	0.05	.035	.83	123	38.8
.0185	0.06	.044	1.05	150	47.2
.0219	0.07	.048	1.14	178	55.9
.0245	0.08	.055	1.31	199	62.5
.0270	0.09	.063	1.50	220	69.0
.0288	0.10	.071	1.69	233	73.0
.0293	0.11	.081	1.93	237	74.1
.0284	0.12	.092	2.20	230	71.7
.0260	0.13	.104	2.48	211	64.4
.0235	0.14	.117	2.79	190	58.8
.0210	0.15	.129	3.06	170	52.4
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Project ____

Code No's. C-212

Technician BPS

Date: February 10/56

Specimen		2121	2122
Test -- Compression		x	x
Length	ins.	4.15	4.16
Diameter	ins.	2.00	2.00
Volume	cc's	213.6	214.2
Unit Weight	#/cu.ft.	137.9	137.7
Cross-sect. Area	sq.ins	3.14	3.14
Test -- Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.ins		
Unit Weight	#/cu.ft.		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky-Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	January 20/56
Date Tested	February 10/56
Testing Temperature	75 °F
Accelerated Aging:	29 hrs. @140 °F
Rate of Strain	0.08 in/min.
Proving Ring	400 #Cap.

2121

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0027	0.01	.0097	.23	21	6.7
.0053	0.02	.015	.36	43	13.7
.0084	0.03	.022	.53	69	21.9
.0103	0.04	.030	.72	83	26.4
.0145	0.05	.035	.84	118	37.5
.0182	0.06	.042	1.01	153	48.6
.0218	0.07	.048	1.16	177	56.2
.0250	0.08	.055	1.33	202	64.1
.0282	0.09	.062	1.49	229	72.8
.0303	0.10	.070	1.69	245	77.9
.0316	0.11	.080	1.93	255	81.1
.0316	0.12	.090	2.17	255	81.1
.0305	0.13	.100	2.41	246	78.2
.0282	0.14	.112	2.70	229	72.8
.0251	0.15	.125	3.02	202	64.2
.0218	0.16	.139	3.35	177	56.3
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2122

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0031	0.01	.0097	.23	25	7.9
.0063	0.02	.014	.34	52	16.5
.0093	0.03	.021	.50	75	23.8
.0127	0.04	.027	.65	103	32.6
.0159	0.05	.034	.82	129	41.0
.0195	0.06	.040	.96	158	50.6
.0230	0.07	.047	1.13	186	59.1
.0265	0.08	.053	1.27	216	68.6
.0293	0.09	.061	1.47	237	75.4
.0311	0.10	.069	1.66	252	80.1
.0317	0.11	.079	1.90	257	81.6
.0310	0.12	.089	2.14	252	80.1
.0289	0.13	.101	2.43	235	74.8
.0258	0.14	.115	2.77	209	66.5
.0220	0.15	.128	3.10	179	56.9
.0190	0.16	.141	3.39	155	49.3
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 7

Project

Code No's. C-214

Technician BPS

Date: February 10/56

Specimen		2141	2142
Test -- Compression		x	x
Length	ins.	4.18	4.20
Diameter	ins.	2.00	2.00
Volume	cc's	215.2	216.2
Unit Weight	#/cu.ft.	141.8	140.5
Cross-sect. Area	sq.ins.	3.14	3.14
Test -- Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.ins.		
Unit Weight	#/cu.ft.		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky-Pen ~~200~~-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	January 22/56
Date Tested	February 10/56
Testing Temperature	75 °F
Accelerated Aging:	29 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	400 #Cap.

#2141						#2142					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0037	0.01	.0096	.23	31	9.9	.0044	0.01	.0093	.23	35	11.1
.0074	0.02	.013	.31	60	19.1	.0073	0.02	.013	.31	59	18.8
.0108	0.03	.020	.48	88	28.0	.0103	0.03	.020	.48	83	26.4
.0148	0.04	.026	.62	120	38.2	.0137	0.04	.027	.64	111	35.3
.0189	0.05	.031	.74	154	48.9	.0174	0.05	.033	.79	141	44.8
.0232	0.06	.037	.88	189	60.1	.0211	0.06	.039	.93	171	54.4
.0278	0.07	.042	1.01	227	72.2	.0245	0.07	.046	1.09	199	63.2
.0342	0.08	.048	1.15	263	83.6	.0285	0.08	.052	1.24	231	73.4
.0358	0.09	.054	1.29	290	92.2	.0315	0.09	.059	1.41	255	85.1
.0389	0.10	.061	1.46	315	100.3	.0342	0.10	.066	1.57	277	88.1
.0413	0.11	.070	1.67	333	105.9	.0358	0.11	.074	1.76	289	91.9
.0419	0.12	.080	1.91	335	106.5	.0361	0.12	.084	2.00	293	93.2
.0410	0.13	.090	2.16	332	105.8	.0350	0.13	.095	2.36	283	90.0
.0385	0.14	.101	2.42	312	99.2	.0329	0.14	.107	2.55	266	84.6
.0346	0.15	.115	2.76	280	89.0	.0301	0.15	.120	2.86	243	77.3
.0300	0.16	.130	3.11	242	76.9	.0267	0.16	.134	3.19	217	69.0
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

Sheet 8

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Project
Code No's. C-216
Technician BPS
Date: February 10/56

Specimen		
Test -- Compression	x	x
Length ins.	4.18	4.13
Diameter ins.	2.00	2.00
Volume cc's	215.2	212.6
Unit Weight #/cu.ft.	137.8	138.2
Cross-sect. Area sq.ins.	3.14	3.14
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.ins.		
Unit Weight #/cu.ft.		
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky-Pen 200-300
% Additive	6.0
Type Additive	Poly 119 (Comm)
Date Fabricated	January 23/56
Date Tested	February 10/56
Testing Temperature	75 °F
Accelerated Aging:	29 hrs. @ 140 °F
Rate of Strain	.08 in/min.
Proving Ring	400 #Cap.

#2161						#2162					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0037	0.01	.0093	.22	31	9.9	.0037	0.01	.0096	.23	31	9.9
.0073	0.02	.013	.31	60	19.1	.0072	0.02	.013	.31	60	19.1
.014	0.03	.020	.48	83	26.4	.0106	0.03	.020	.48	84	26.7
.0138	0.04	.026	.62	111	35.3	.0140	0.04	.026	.63	114	36.2
.0172	0.05	.033	,79	140	44.5	.0181	0.05	.032	.77	147	46.7
.0209	0.06	.039	.93	170	54.1	.0223	0.06	.038	.91	181	57.5
.0245	0.07	.046	1.10	199	63.3	.0265	0.07	.044	1.13	215	68.4
.0283	0.08	.052	1.24	229	72.8	.0313	0.08	.049	1.19	255	81.1
.0316	0.09	.058	1.39	256	81.4	.0354	0.09	.055	1.33	287	91.3
.0344	0.10	.066	1.58	279	88.7	.0389	0.10	.061	1.48	315	100.3
.0362	0.11	.074	1.77	293	93.2	.0424	0.11	.068	1.65	343	109.2
.0370	0.12	.083	1.97	300	95.4	.0444	0.12	.076	1.84	358	113.8
.0366	0.13	.094	2.25	296	94.1	.0450	0.13	.085	2.08	364	115.8
.0349	0.14	.105	2.45	282	89.6	.0440	0.14	.096	2.32	357	113.5
.0322	0.15	.118	2.83	261	83.0	.0413	0.15	.109	2.66	333	105.9
.0289	0.16	.137	3.14	224	71.2	.0365	0.16	.124	3.01	296	94.1
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

Asphalt Surfacing Investigation

C-310
BPS
Feb 10/56

Specimen	3101	3102
Test — Compression	x	x
Length in.	4.02	4.10
Diameter in.	2.00	2.00
Volume cc	206.9	211.1
Unit Weight	143.6	140.3
Cross-sect. Area sq. in.	3.14	3.14
Test — Flexure		
Width in.		
Depth in.		
Cross-sect. Area sq. in.		
Unit Weight		
Volume cc		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	Polythene 119 Comm
Type Additive / Date Fabricated	Jan 18/56
Date Tested	Feb 10/56
Testing Temperature	75 °F
Accelerated Aging	70 hrs. @ 140 °F
Rate of Strain	0.08 in/min
Proving Ring	400 #Cap

3101						3102					
Proving Ring	Def. Dial	True Def.	% Strain	Load lb	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load lb	Stress psi
.0000	0.00					.0000	0.00				
.0028	0.01	.0097	.24	21	6.7	.0025	0.01	.0097	.24	20	6.3
.0055	0.02	.014	.35	45	14.3	.0052	0.02	.015	.36	42	13.4
.0087	0.03	.021	.52	71	22.6	.0082	0.03	.022	.53	67	21.4
.0188	0.04	.028	.70	95	30.3	.0110	0.04	.029	.71	89	28.4
.0151	0.05	.035	.87	123	39.2	.0142	0.05	.036	.88	116	37.0
.0188	0.06	.042	1.04	153	48.7	.0178	0.06	.042	1.05	144	45.9
.0227	0.07	.047	1.17	184	58.6	.0216	0.07	.049	1.20	175	55.6
.0264	0.08	.053	1.32	213	67.8	.0254	0.08	.055	1.34	206	65.6
.0301	0.09	.060	1.49	243	77.3	.0291	0.09	.061	1.49	236	75.2
.0335	0.10	.066	1.65	271	86.3	.0319	0.10	.068	1.66	258	82.1
.0365	0.11	.074	1.84	296	94.2	.0345	0.11	.076	1.85	279	88.9
.0383	0.12	.082	2.04	310	98.6	.0358	0.12	.084	2.05	289	92.0
.0388	0.13	.092	2.29	315	100.1	.0361	0.13	.094	2.29	293	93.4
.0385	0.14	.102	2.54	312	99.4	.0350	0.14	.105	2.56	283	90.0
.0360	0.15	.114	2.84	291	92.6	.0324	0.15	.118	2.88	262	83.5
.0330	0.16	.127	3.16	267	85.0	.0290	0.16	.131	3.20	235	74.8
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

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Dept. of Civil Engineering

ASPHALT ADMIXTURE [illegible]

Sheet 10

Project

Code # C-312

Computed BPS

Date: Feb 10/56

Specimen		3121	3122
Test — Compression		x	x
Length	Ins.	4.16	4.24
Diameter	Ins.	2.00	2.00
Volume	cc's	214.2	218.3
Unit Weight	#/cu.ft	138.9	141.2
Cross-sect. Area	sq.Ins.		
Test — Tension			
Width	Ins.		
Depth	Ins.		
Cross-sect. Area	sq.Ins.		
Unit Weight	#/cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 21/56
Date Tested	Feb 10/56
Testing Temperature	75 °F
Aged [illegible]	70 hrs. @ 140 °F
Rate of Strain	0.08 in/min.
Proving Ring	400 #Cap.

3121

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0037	0.01	.0097	.23	30	9.5
.0069	0.02	.013	.31	56	17.8
.0100	0.03	.020	.48	81	25.8
.0133	0.04	.027	.65	107	34.1
.0166	0.05	.033	.79	135	43.0
.0199	0.06	.040	.96	161	51.3
.0235	0.07	.047	1.13	191	60.8
.0275	0.08	.053	1.27	223	71.0
.0308	0.09	.060	1.44	249	79.3
.0343	0.10	.066	1.59	277	88.2
.0364	0.11	.076	1.83	294	93.6
.0381	0.12	.082	1.97	308	98.1
.0385	0.13	.092	2.22	312	99.3
.0377	0.14	.103	2.48	305	97.1
.0359	0.15	.115	2.77	291	92.6
.0327	0.16	.128	3.06	265	84.4
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3122

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0034	0.01	.0097	.23	27	8.6
.0068	0.02	.014	.33	35	11.2
.0100	0.03	.020	.47	81	25.8
.0135	0.04	.027	.63	109	34.7
.0175	0.05	.032	.75	142	45.2
.0210	0.06	.039	..92	170	54.1
.0257	0.07	.044	1.04	208	66.2
.0302	0.08	.050	1.18	244	77.6
.0339	0.09	.056	1.32	274	87.3
.0375	0.10	.062	1.46	303	96.5
.0395	0.11	.070	1.65	320	101.9
.0417	0.12	.079	1.86	337	107.3
.0421	0.13	.088	2.08	341	108.7
.0409	0.14	.099	2.33	331	105.2
.0382	0.15	.112	2.64	309	98.4
.0342	0.16	.126	2.97	277	88.2
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

Dept. of Civil [illegible]

ASPHALT ADMIXTURE [illegible]

C-314

BPS

Feb 10/56

Specimen	3141	3142
Test -- Compression	x	x
Length ins.	4.12	4.23
Diameter ins.	2.00	2.00
Volume cc's	213.0	218.3
Unit Weight #/cu.ft.	139.9	139.8
Cross-sect. Area sq.in.		
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.in.		
Unit Weight #/cu.ft.		
Volume cc's		

[illegible]	8.0
Type [illegible] Cement	Husky Pen 200-300
[illegible]	4.0
[illegible]	Polythene 119 Comm
[illegible]	Jan 23/56
[illegible]	Feb 10/56
[illegible]	75 °F
[illegible]	70 hrs. @140°F
[illegible]	0.08 in/min.
[illegible]	400 #Cap.

#3141 Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	#3142 Proving Ring	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000				
.0028	0.01	.0097	.24	21	6.7	.0035	.0096	.23	28	8.9
.0056	0.02	.014	.34	45	14.3	.0065	.013	.33	52	16.6
.0088	0.03	.021	.51	71	23.6	.0100	.020	.47	81	25.8
.0124	0.04	.028	.68	100	31.8	.0135	.027	.63	109	34.7
.0157	0.05	.034	.83	128	40.7	.0173	.033	.78	140	44.6
.0197	0.06	.040	.97	161	51.3	.0208	.039	.92	169	53.8
.0235	0.07	.047	1.14	190	60.4	.0248	.045	1.06	202	64.3
.0275	0.08	.053	1.29	223	71.0	.0289	.051	1.20	234	74.5
.0316	0.09	.059	1.43	256	81.5	.0328	.057	1.34	266	84.6
.0353	0.10	.065	1.58	286	91.1	.0360	.064	1.51	291	92.5
.0387	0.11	.072	1.75	314	100.0	.0389	.071	1.68	315	100.1
.0409	0.12	.079	1.92	331	105.4	.0408	.079	1.86	330	105.1
.0422	0.13	.088	2.14	341	108.6	.0418	.089	2.10	339	108.0
.0420	0.14	.098	2.38	340	108.3	.0415	.099	2.33	336	108.0
.0400	0.15	.110	2.67	324	103.2	.0400	.110	2.60	324	103.2
.0370	0.16	.123	3.00	300	95.5	.0378	.121	2.86	307	97.8
.0330	0.17	.137	3.33	267	85.0					
	0.18									
	0.19									
	0.20									
	0.21									
	0.22									
	0.23									
	0.24									
	0.25									
	0.26									

Dept. of Civil Eng.

Sheet 12

ASPHALT ADMIXTURE

Job No.	C-316
Tested	BPS
Date:	Feb 10/56

Specimen	3161	3162
Test -- Compression	x	x
Length Ins.	4.20	4.14
Diameter Ins.	2.00	2.00
Volume cc	216.2	213.1
Unit Weight #/cu.ft	139.5	139.6
Cross-sect. Area sq.in	3.14	3.14
Test -- Tension		
Width Ins.		
Depth Ins.		
Cross-sect. Area sq.in		
Unit Weight #/cu.ft		
Volume cc		

% Asphaltic Cement	8.0
Type Asphaltic Cement	Husky Pen 200-300
% Add.	6.0
Type Additive	Polythene 119 Comm
Date Molded	Jan 23/56
Date Tested	Feb 10/56
Testing Temperature	°F
Curing Conditions	hrs. @ °F
Rate of Loading	in/min.
Proving Ring	#Cap.

#3161						#3162					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000					
.0045	0.01	.0095	.23	37	11.8	.0039		.0096	.23	28	8.9
.0084	0.02	.012	.29	66	21.0	.0074		.013	.31	60	19.1
.0121	0.03	.018	.43	98	31.2	.0108		.019	.46	88	28.0
.0161	0.04	.024	.51	131	41.7	.0146		.026	.63	119	37.9
.0202	0.05	.030	.71	163	51.9	.0188		.031	.75	153	48.7
.0247	0.06	.036	.86	201	64.0	.0227		.037	.89	183	58.3
.0295	0.07	.041	.98	239	76.1	.0273		.043	1.04	221	70.4
.0343	0.08	.046	1.10	277	88.2	.0315		.049	1.18	247	78.6
.0389	0.09	.051	1.22	315	100.6	.0357		.054	1.31	289	92.0
.0430	0.10	.057	1.36	348	110.8	.0395		.061	1.47	320	101.9
.0468	0.11	.064	1.53	379	120.8	.0428		.069	1.62	346	110.2
.0499	0.12	,070	1.67	404	128.9	.0450		.075	1.81	363	115.5
.0519	0.13	.078	1.86	420	134.9	.0463		.084	2.03	374	119.1
.0525	0.14	.088	2.10	426	135.8	.0463		.094	2.37	374	119.1
.0515	0.15	.098	2.34	415	132.1	.0443		.106	2.56	358	114.0
.0390	0.16	.111	2.64	316	100.3	.0414		.119	2.88	335	106.8
.0352	0.17	.135	3.22	285	90.7	.0373		.133	3.21	302	96.1
.0300	0.18	.150	3.57	241	76.7	.0327		.148	3.58	265	84.4
	0.19										
	0.20										
	0.21										
	0.22										
	0.23										
	0.24										
	0.25										
	0.26										

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet	13
Project	
Job No.	C-140
Tested by	BPS
Date	February 10/56

Specimen	1401	1402
Test -- Compression	x	x
Length ins.	4.15	4.05
Diameter ins.	2.00	2.00
Volume cc's	213.6	208.5
Unit Weight #/cu.ft	142.2	142.5
Cross-sect. Area sq.ins	3.14	3.14
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.ins		
Unit Weight #/cu.ft		
Volume cc's		

% Cement	8.0
Type Cement	Husky Pen 200-300
[illegible]	0
[illegible]	-
Date Prepared	Jan 18/56
Date Tested	Feb 10/56
Testing Temperature	140 °F
[illegible]	- hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	400 #Cap.

#1401

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0006	0.01	.0099	.24	4	1.26
.0017	0.02	.018	.43	13	4.14
.0028	0.03	.027	.65	23	7.32
.0037	0.04	.036	.87	31	9.86
.0042	0.05	.046	1.11	34	10.82
.0039	0.06	.056	1.35	32	10.20
.0032	0.07	.067	1.62	26	8.27
.0025	0.08	.077	1.86	20	6.37
.0019	0.09	.088	2.12	15	4.77
.0014	0.10	.099	2.39	11	3.50
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

#1402

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000					
.0006		.0099	.24	4	1.26
.0016		.018	.44	13	4.14
.0025		.027	.67	20	6.37
.0029		.037	.91	23	7.31
.0028		.047	1.16	23	7.31
.0024		.058	1.43	19	6.05
.0019		.068	1.68	15	4.78
.0013		.079	1.95	11	3.50
.0010		.089	2.20	8	2.55

Dept. of Civil Engineering

ASPHALT ADMIXTURE [illegible]

Sheet 14

Subject	
[illegible]	C-142
[illegible]	BPS
Date	Feb 10/56

Specimen	1421	1422
Test -- Compression	x	x
Length ins.	4.03	3.83
Diameter ins.	2.00	2.00
Volume cc's	207.46	197.2
Unit Weight #/cu.ft.	137.8	136.4
Cross-sect. Area sq.ins.	3.14	3.14
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.ins.		
Unit Weight #/cu.ft.		
Volume cc's		

% [illegible] Cement	8.0
[illegible] Cement	Husky Pen 200-300
% Additive	2
Type Additive	Polythene 119 Comm
Date [illegible] cored	Jan 20/56
Date Tested	Feb 10/56
[illegible] Temperature	140 °F
[illegible] Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	400 #Cap.

1421

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0006	0.01	.01	.25	4	1.27
.0014	0.02	.019	.47	11	3.50
.0023	0.03	.028	.69	19	6.05
.0030	0.04	.037	.92	24	7.64
.0033	0.05	.047	1.17	26	8.28
.0029	0.06	.057	1.41	23	7.32
.0025	0.07	.067	1.66	20	6.36
.0019	0.08	.078	1.93	15	4.78
.0014	0.09	.089	2.21	11	3.50
.0010	0.10	.099	2.46	8	2.55
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1422

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0009	0.01	.010	.26	7	2.23
.0017	0.02	.019	.50	13	4.14
.0024	0.03	.028	.73	19	6.05
.0026	0.04	.037	.97	21	6.69
.0023	0.05	.048	1.25	19	6.05
.0019	0.06	.058	1.52	15	4.78
.0014	0.07	.069	1.80	11	3.50
.0011	0.08	.079	2.06	9	2.87
.0007	0.09	.089	2.33	5	1.59
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

Sheet 15

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Project
Group No. C-144
Tested by BPS
Date Feb 10/56

Specimen	1441	1442
Test -- Compression	x	x
Length ins.	4.12	4.15
Diameter ins.	2.00	2.00
Volume cc's	213.00	213.6
Unit Weight #/cu.ft	139.15	140.5
Cross-sect. Area sq.ins	3.14	3.14
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.ins		
Unit Weight #/cu.ft		
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 22/56
Date Tested	Feb 10/56
Testing Temperature	140 °F
Specimen Aging	0 hrs. @ °F
Rate of Loading	0.08 in/min.
Proving Ring	400 #Cap.

1441

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0008	0.01	.01	.23	6	1.91
.0019	0.02	.018	.44	15	4.78
.0029	0.03	.028	.68	23	7.3
.0041	0.04	.036	.87	34	10.82
.0049	0.05	.045	1.09	39	12.42
.0050	0.06	.055	1.34	40	12.75
.0042	0.07	.066	1.60	34	10.82
.0035	0.08	.077	1.87	28	8.91
.0027	0.09	.087	2.11	21	6.69
.0021	0.10	.098	2.38	17	5.41
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1442

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0011	0.01	.0099	.24	9	2.87
.0024	0.02	.018	.43	19	6.05
.0037	0.03	.026	.63	30	9.55
.0050	0.04	.035	1.84	40	12.74
.0051	0.05	.045	1.09	41	13.08
.0044	0.06	.056	1.35	36	11.46
.0032	0.07	.067	1.62	26	8.28
.0025	0.08	.077	1.86	20	6.37
.0020	0.09	.088	2.12	16	5.10
.0012	0.10	.099	2.39	9	2.87
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

Dept. of [illegible]

ASPHALT ADMIXTURE [illegible]

[illegible]	C-146
[illegible]	BPS
[illegible]	Feb 10/56

Specimen	1461	1462
Test -- Compression	x	x
Length in.	4.24	4.14
Diameter in.	2.00	2.00
Volume cc	218.3	213.1
Unit Weight #/cc	3.14	3.14
Cross-sect. Area sq. in.		
Test -- Tension		
Width in.		
Depth in.		
Cross-sect. Area sq. in.		
Unit Weight #/cc		
Volume cc		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
[illegible]	6.0
Type Additive	Polythene 119 Comm
[illegible]	Jan 23/56
[illegible]	Feb 10/56
[illegible]ture	140 °F
[illegible]	0 hrs. @ - °F
[illegible]	0.08 in/min
[illegible]	400 #Cap

# 1461						# 1462					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0009	0.01	.0099	.23	6	1.91	.0011	0.01	.0099	.24	9	2.87
.0019	0.02	.018	.42	15	4.78	.0022	0.02	.018	.43	18	5.74
.0032	0.03	.027	.64	26	8.28	.0035	0.03	.026	.63	28	8.91
.0045	0.04	.036	.85	37	11.78	.0054	0.04	.035	.84	44	14.02
.0055	0.05	.045	1.06	44	14.02	.0069	0.05	.043	1.04	56	17.86
.0056	0.06	.054	1.27	45	15.92	.0073	0.06	.053	1.28	59	18.80
.0047	0.07	.065	1.53	38	12.11	.0064	0.07	.064	1.55	52	16.58
.0040	0.08	.076	1.79	32	10.20	.0050	0.08	.075	1.81	40	12.74
.0032	0.09	.087	2.05	26	8.28	.0038	0.09	.086	2.08	31	9.86
.0027	0.10	.097	2.29	22	7.01	.0028	0.10	.097	2.34	23	7.32
	0.11						0.11				
	0.12						0.12				
	0.13						0.13				
	0.14						0.14				
	0.15						0.15				
	0.16						0.16				
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Project
Code No's. C-240
Technician BPS
Date: Feb 10/56

Specimen		2401	2402
Test -- Compression		x	x
Length	ins.	4.14	4.05
Diameter	ins.	2.00	2.00
Volume	cc's	213.1	208.5
Unit Weight	#/cu.ft.	137.5	140.8
Cross-sect. Area	sq.ins.	3.14	3.14
Test -- Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.ins.		
Unit Weight	#/cu.ft.		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	-
Date Fabricated	Jan 19/56
Date Tested	Feb 10/56
Testing Temperature	140 °F
Accelerated Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min
Proving Ring	400 #Cap.

# 2401						# 2402					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0003	0.01	.0097	.23	2.5	.795	.0007	0.01	.0093	.23	6.0	1.91
.0008	0.02	.0192	.46	6.0	1.91	.0016	0.02	.018	.44	12.5	3.98
.0013	0.03	.0287	.70	10.0	3.18	.0025	0.03	.027	.67	20.0	6.37
.0014	0.04	.0386	.94	11.0	3.51	.0031	0.04	.037	.91	24.5	7.80
.0013	0.05	.0487	1.18	10.0	3.18	.0033	0.05	.047	1.16	26	8.28
.0010	0.06	.0590	1.43	8.0	2.55	.0031	0.06	.051	1.41	24.5	7.80
.0007	0.07	.0693	1.68	5.0	1.59	.0028	0.07	.067	1.66	23.0	7.33
.0005	0.08	.0795	1.92	3.0	0.96	.0025	0.08	.077	1.90	20.0	6.36
.0003	0.09	.0897	2.15	2.5	.795	.0019	0.09	.088	2.16	15.5	4.95
	0.10						0.10				
	0.11						0.11				
	0.12						0.12				
	0.13						0.13				
	0.14						0.14				
	0.15						0.15				
	0.16						0.16				
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

University of Alberta

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 18

Project

Code No's. C-242

Technician BPS

Date: Feb 10/56

Specimen	2421	2422
Test -- Compression	x	x
Length ins	4.19	4.13
Diameter ins.	2.00	2.00
Volume cc's	215.7	212.6
Unit Weight #/cu.ft.	142.9	139.8
Cross-sect. Area sq.ins.	3.14	3.14
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.in		
Unit Weight #/cu.ft.		
Volume cc's		

% Asphalt Cont.	8.0
Type Asphalt	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 20/56
Date Tested	Feb 10/56
Testing Temperature	140 °F
Accelerated Aging:	29 hrs @ 140
Rate of Strain	0.08 in/min
Proving Ring	400 #Cap

2421 / # 2422

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0012	0.01	.0088	.22	9.0	2.87	.0010	0.01	.0090	.22	8.0	2.55
.0024	0.02	.018	.44	19.5	6.21	.0019	0.02	.018	.44	15.5	4.93
.0037	0.03	.026	.64	29.0	9.24	.0029	0.03	.027	.67	23.5	7.49
.0048	0.04	.035	.86	39.5	12.58	.0042	0.04	.036	.89	34.0	10.82
.0051	0.05	.045	1.11	41.5	13.22	.0049	0.05	.045	1.11	39.5	12.58
.0049	0.06	.055	1.36	40.0	12.75	.0042	0.06	.056	1.38	34.0	10.82
.0046	0.07	.065	1.61	37.0	11.78	.0032	0.07	.067	1.65	26.0	8.28
.0043	0.08	.076	1.88	35.0	11.15	.0024	0.08	.078	1.93	19.5	6.21
.0037	0.09	.086	2.13	31.0	9.86	.0018	0.09	.088	2.18	15.0	4.78
.0030	0.10	.097	2.40	24.0	7.64	.0014	0.10	.099	2.45	11.0	3.51
	0.11						0.11				
	0.12						0.12				
	0.13						0.13				
	0.14						0.14				
	0.15						0.15				
	0.16						0.16				
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 19

Project
Code No's. C-244
Technician BPS
Date: February 10/56

Specimen	2441	2442
Test -- Compression	x	x
Length ins.	4.20	4.17
Diameter ins.	2.00	2.00
Volume cc's	216.2	214.7
Unit Weight #/cu.ft.	140.6	141.1
Cross-sect. Area sq.ins.	3.14	3.14
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.ins.		
Unit Weight #/cu.ft.		
Volume cc's		

% Asphalt Ce	8.0
Type Asphalt	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabric.	Jan 22/56
Date Tested	Feb 10/56
Testing Temperature	140 °F
Accelerated Aging:	29 hrs. @140 °F
Rate of Strain	0.08 in/min
Proving Ring	400 #Cap

2441

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0013	0.01	.0087	.21	10.0	3.18
.0029	0.02	.017	.40	23.5	7.48
.0047	0.03	.025	.60	38.0	12.10
.0068	0.04	.033	.78	55.0	17.52
.0087	0.05	.041	.98	71.0	22.62
.0089	0.06	.051	1.22	72.0	22.95
.0075	0.07	.062	1.48	61.0	19.43
.0055	0.08	.074	1.76	44.0	14.02
.0039	0.09	.086	2.05	31.0	9.86
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2442

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0013	0.01	.0087	.21	10.0	3.18
.0028	0.02	.017	.41	23.0	7.32
.0046	0.03	.025	.60	37.0	11.78
.0066	0.04	.033	.79	54.0	17.20
.0087	0.05	.041	.98	71.0	22.61
.0093	0.06	.051	1.22	75.0	23.90
.0080	0.07	.062	1.49	65.0	20.70
.0060	0.08	.074	1.78	48.5	15.45
.0042	0.09	.086	2.06	34.0	10.83
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 20

Project

Code No's. C-246

Technician BPS

Date: Feb 10/56

Specimen	2461	2462
Test -- Compression	x	x
Length ins.	4.21	4.19
Diameter ins.	2.00	2.00
Volume cc's	216.7	215.7
Unit Weight #/cu.ft.	141.2	139.8
Cross-sect. Area sq.ins.	3.14	3.14
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.ins.		
Unit Weight #/cu.ft.		
Volume cc's		

% Asphalt Content	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 23/56
Date Tested	Feb 10/56
Testing Temperature	140 °F
Accelerated Aging:	29 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	400 #Cap.

2461

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0013	0.01	.0087	.21	10.0	3.18
.0027	0.02	.017	.40	22.0	7.02
.0047	0.03	.025	.59	38.0	12.10
.0078	0.04	.032	.76	63.5	20.25
.0105	0.05	.040	.95	85.0	27.10
.0126	0.06	.047	1.12	102.0	32.50
.0132	0.07	.057	1.36	106.5	34.90
.0115	0.08	.069	1.64	93.0	29.65
.0095	0.09	.081	1.93	77.0	24.55
.0068	0.10	.093	2.21	55.0	17.53
.0051	0.11	.105	2.50	41.5	13.22
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2462

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0014	0.01	.0086	.21	11.5	3.66
.0029	0.02	.017	.41	23.5	7.48
.0050	0.03	.025	.60	40.5	12.90
.0076	0.04	.032	.76	61.5	19.60
.0101	0.05	.040	.95	81.0	25.82
.0121	0.06	.048	1.15	98.0	31.25
.0126	0.07	.057	1.36	102.5	32.65
.0107	0.08	.069	1.65	86.5	27.55
.0085	0.09	.081	1.93	69.0	21.65
.0065	0.10	.094	2.24	52.5	16.73
.0043	0.11	.106	2.53	34.0	10.83
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 21

Project

Code No's. C-340

Technician BPS

Date: Feb 10/56

Specimen	3401	3402
Test -- Compression	x	x
Length Ins.	4.15	4.20
Diameter Ins.	2.00	2.00
Volume cc's	213.6	216.2
Unit Weight #/cu.ft.	141.0	136.9
Cross-sect. Area sq.ins.	3.14	3.14
Test -- Tension		
Width Ins.		
Depth Ins.		
Cross-sect. Area sq.ins.		
Unit Weight #/cu.ft.		
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	-
Date Fabricated	Jan 19/56
Date Tested	Feb 10/56
Testing Temperature	140 °F
Accelerated Aging:	70 hrs. @ 140 °F
Rate of Strain	0.08 in/min.
Proving Ring	400 #Cap.

3401

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0011	0.01	.0089	.21	8.0	2.55
.0021	0.02	.0179	.43	17.0	5.42
.0031	0.03	.0269	.65	24.5	7.81
.0039	0.04	.036	.87	31.5	10.05
.0044	0.05	.046	1.11	35.5	11.32
.0042	0.06	.056	1.35	34.0	10.82
.0035	0.07	.066	1.59	28.0	8.25
.0028	0.08	.077	1.86	22.0	7.01
.0022	0.09	.088	2.12	17.0	5.42
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3402

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0088	0.01	.0092	.22	6.0	1.91
.0015	0.02	.0185	.44	12.0	3.82
.0024	0.03	.028	.67	19.5	6.21
.0029	0.04	.0037	.88	23.5	7.49
.0031	0.05	.047	1.12	24.5	7.81
.0030	0.06	.057	1.36	24.0	7.56
.0027	0.07	.067	1.60	22.0	7.01
.0023	0.08	.078	1.86	19.0	6.06
.0019	0.09	.088	2.10	15.5	4.94
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 22

Project:
Code Index: C-342
Admixture: BPS
Date: Feb 10/56

Specimen	3421	3422
Test - Compression	x	x
Length ins	4.20	4.13
Diameter ins	2.00	2.00
Volume cc	216.2	212.6
Unit Weight #/cu ft	140.8	140.6
Cross-sect. Area sq. in	3.14	3.14

% Asphalt	8.0
Type Asphalt	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 21/56
Date Tested	Feb 10/56

Test - Tension		
Width ins		
Depth ins		
Cross-sect. Area sq. in		
Unit Weight #/cu ft		
Volume cc		

Testing Temperature	140
Accelerate	70 hrs. at 140
Rate of Strain	0.08
Proving Ring	400

3421

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0008	0.01	.0092	.22	6.0	1.91
.0019	0.02	.0181	.43	15.5	4.94
.0031	0.03	.027	.64	24.5	6.81
.0047	0.04	.035	.83	39.5	12.60
.0060	0.05	.044	1.05	48.5	15.45
.0066	0.06	.053	1.26	52.5	16.73
.0062	0.07	.064	1.52	50.0	15.94
.0052	0.08	.075	1.78	42.0	13.39
.0038	0.09	.086	2.05	31.0	9.87
.0027	0.10	.097	2.31	22.0	7.03
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				

3422

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0010	0.01	.0090	.22	8.0	2.55
.0022	0.02	.0188	.45	16.5	5.26
.0036	0.03	.026	.63	28.5	9.08
.0055	0.04	.034	.82	44.5	14.18
.0063	0.05	.044	1.07	51.5	16.41
.0069	0.06	.053	1.28	56.0	17.87
.0065	0.07	.064	1.55	52.5	16.73
.0051	0.08	.075	1.82	40.5	12.91
.0040	0.09	.086	2.08	32.5	10.68
.0035	0.10	.096	2.33	28.5	9.09

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 23

Project:
Code No.: C-344
Technician: BPS
Date: Feb 10/56

Specimen	3441	3442
Test -- Compression	x	x
Length ins	4.26	4.30
Diameter ins	2.00	2.00
Volume cc's	219.3	139.5
Unit Weight #/cu ft	221.4	141.7
Cross-sect. Area sq.in	3.14	3.14
Test -- Tension		
Width ins		
Depth ins		
Cross-sect. Area sq.ins		
Unit Weight #/cu ft		
Volume cc's		

% Asphalt	8.0
Type Asphalt	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 22/56
Date Tested	Feb 10/56
Testing Temperature	140
Accelerated Aging	70 140
Rate of Strain	0.08
Proving Ring	400

3441

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0011	0.01	.0089	.21	8.0	2.55
.0022	0.02	.018	.42	16.5	5.26
.0037	0.03	.026	.61	30.5	9.72
.0060	0.04	.034	.80	48.5	15.48
.0080	0.05	.042	.99	65.0	20.7
.0099	0.06	.050	1.17	80.5	25.7
.0104	0.07	.060	1.41	84.5	26.95
.0098	0.08	.070	1.65	80.0	25.5
.0075	0.09	.082	1.93	60.5	19.3
.0055	0.10	.095	2.23	42.5	13.55

3442

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0012	0.01	.0088	.20	9.0	2.87
.0026	0.02	.017	.39	21.0	6.50
.0045	0.03	.025	.58	36.0	11.48
.0072	0.04	.033	.77	58.0	18.50
.0091	0.05	.041	.95	74.0	23.60
.0105	0.06	.050	1.16	85.0	27.15
.0103	0.07	.060	1.40	83.5	76.60
.0087	0.08	.071	1.65	71.0	22.65
.0064	0.09	.084	1.96	51.5	16.42
.0045	0.10	.095	2.21	36.5	11.63

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ASPHALT ADMIXTURE [illegible]CATION

Sheet 24

Project

Comp No. C-346

Technician BPS

Date Feb 10/56

Specimen	3461	3462
Test — Compression	x	x
Length ins.	4.16	4.15
Diameter ins.	2.00	2.00
Volume cc's	214.2	213.5
Unit Weight #/cu.ft	140.3	139.9
Cross-sect. Area sq. ins	3.14	3.14
Test — Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq. in		
Unit Weight #/cu.ft		
Volume cc's		

% Asphalt C[illegible]	8.0
Type Asphal[illegible]	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabric[illegible]	Jan 23/56
Date Tested	Feb 10/56
Testing Temperature	140 °F
Accelerated Aging:	70 hrs. @ 140 °F
Rate of Strain	0.08 in/min.
Proving Ring	400 #'s

#3461 Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	#3462 Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0013	0.01	.0087	.21	9.5	3.03	.0012	0.01	.0088	.21	9.0	2.87
.0025	0.02	.0175	.42	20.0	6.37	.0024	0.02	.017	.41	19.5	6.21
.0042	0.03	.026	.62	34.0	10.83	.0041	0.03	.026	.63	31.5	10.02
.0063	0.04	.034	.82	51.0	16.27	.0061	0.04	.034	.82	49.0	15.62
.0088	0.05	.041	.99	71.5	22.8	.0083	0.05	.042	1.02	67.0	21.38
.0107	0.06	.049	1.18	87.0	27.8	.0098	0.06	.050	1.20	79.0	25.20
.0119	0.07	.058	1.40	97.0	30.9	.0103	0.07	.060	1.45	83.5	26.65
.0119	0.08	.068	1.63	97.0	30.9	.0098	0.08	.070	1.69	80.0	25.50
.0105	0.09	.079	1.90	82.5	26.3	.0085	0.09	.081	1.95	68.5	21.85
.0085	0.10	.091	2.19	68.5	21.8	.0067	0.10	.093	2.14	53.0	16.90
.0069	0.11	.104	2.50	56.0	17.85	.0052	0.11	.105	2.54	42.0	13.40
	0.12						0.12				
	0.13						0.13				
	0.14						0.14				
	0.15						0.15				
	0.16						0.16				
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet	25
Project	
Code No's.	T-110
Technician	BPS
Date:	Feb 11/56

Specimen		1101	1102
Test -- Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.in		
Test -- Tension		x	x
Width	ins.	1.00	1.00
Depth	ins.	1.03	1.00
Cross-sect. Area	sq.in	1.03	1.00
Unit Weight	#/Cu.ft	139.1	139.3
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	-
Date Fabricated	Jan 25/56
Date Tested	Feb 11/56
Testing Temperature	75 °F
Accelerated Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	25 #Cap.

#1101

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0009	0.01	.0091	.23	.63	.61
.0023	0.02	.018	.45	1.25	1.21
.0031	0.03	.027	.68	2.16	2.10
.0035	0.04	.036	.90	2.47	2.40
.0036	0.05	.046	1.15	2.51	2.44
.0036	0.06	.056	1.40	2.51	2.44
.0040	0.07	.066	1.65	2.79	2.71
.0040	0.08	.076	1.90	2.79	2.71
.0039	0.09	.086	2.15	2.72	2.64
.0034	0.10	.097	2.43	2.37	2.30
.0030	0.11	.107	2.68	2.09	2.03
.0026	0.12	.117	2.93	1.81	1.76
.0022	0.13	.128	3.20	1.55	1.51
.0013	0.14	.139	3.48	0.91	0.88
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1102

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0014	0.01	.0086	.22	0.97	0.97
.0028	0.02	.017	.42	1.95	1.95
.0037	0.03	.026	.65	2.58	2.58
.0037	0.04	.036	.90	2.58	2.58
.0043	0.05	.046	1.15	3.00	3.00
.0043	0.06	.056	1.40	3.00	3.00
.0043	0.07	.066	1.65	3.00	3.00
.0040	0.08	.076	1.90	2.79	2.79
.0033	0.09	.087	2.18	2.30	2.30
.0026	0.10	.097	2.43	1.81	1.81
.0021	0.11	.108	2.70	1.46	1.46
.0008	0.12	.112	2.80	0.56	0.56
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet	26
Project	
Code No's.	T-112
Technician	BPS
Date:	Feb 11/56

Specimen	1121	1122
Test -- Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test -- Tension	x	x
Width ins.	1.00	1.08
Depth ins.	1.02	0.99
Cross-sect. Area sq.in	1.02	1.07
Unit Weight #/Cu.ft	142.0	139.8
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 26/56
Date Tested	Feb 11/56
Testing Temperature	75 °F
Accelerated Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	25 #Cap.

# 1121 Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	# 1122 Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0008	0.01	.0092	.23	0.56	.55	.0009	0.01	.0091	.23	.63	.59
.0017	0.02	.018	.45	1.18	1.16	.0014	0.02	.019	.47	.98	.92
.0029	0.03	.027	.68	2.02	1.98	.0018	0.03	.028	.70	1.25	1.17
.0037	0.04	.036	.90	2.58	2.53	.0015	0.04	.039	.98	1.04	0.97
.0041	0.05	.046	1.15	2.86	2.80	.0012	0.05	.049	1.23	.84	0.78
.0041	0.06	.056	1.40	2.86	2.80	.0014	0.06	.059	1.48	.98	0.92
.0037	0.07	.066	1.65	2.58	2.53	.0015	0.07	.069	1.73	1.04	0.97
.0016	0.08	.078	1.95	1.12	1.10	.0020	0.08	.078	1.95	1.39	1.30
.0007	0.09	.089	2.23	0.49	0.48	.0020	0.09	.088	2.20	1.39	1.30
.0002	0.10	.100	2.50	0.14	0.14	.0025	0.10	.098	2.45	1.74	1.63
	0.11					.0031	0.11	.107	2.68	2.16	2.04
	0.12					.0034	0.12	.117	2.93	2.37	2.21
	0.13					.0037	0.13	.126	3.14	2.58	2.41
	0.14					.0037	0.14	.136	3.40	2.58	2.41
	0.15					.0037	0.15	.146	3.65	2.58	2.41
	0.16					.0034	0.16	.157	3.92	2.37	2.22
	0.17					.0022	0.17	.168	4.20	1.53	1.43
	0.18					.0010	0.18	.179	4.47	0.70	0.65
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

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Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 27

Project

Code No's. T-114

Technician BPS

Date: Feb 11/56

Specimen		1141	1142
Test -- Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.In		
Test -- Tension		x	x
Width	ins.	1.00	1.06
Depth	ins.	0.99	0.94
Cross-sect. Area	sq.in	0.99	1.00
Unit Weight	#/Cu.ft	141.7	141.3
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 27/56
Date Tested	Feb 11/56
Testing Temperature	75 °F
Accelerated Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	25 #Cap.

#1141

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0007	0.01	.0093	.23	.49	.495
.0014	0.02	.019	.47	.97	.98
.0024	0.03	.028	.70	1.67	1.69
.0034	0.04	.037	.92	2.36	2.38
.0041	0.05	.046	1.15	2.86	2.89
.0043	0.06	.056	1.40	3.00	3.03
.0043	0.07	.066	1.65	3.00	3.03
.0041	0.08	.076	1.90	2.86	2.89
.0036	0.09	.086	2.15	2.51	2.53
.0032	0.10	.097	2.43	2.23	2.25
.0020	0.11	.108	2.70	1.39	1.40
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

#1142

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0012	0.01	.0088	.22	.84	.84
.0020	0.02	.018	.45	1.39	1.39
.0024	0.03	.028	.70	1.67	1.67
.0033	0.04	.037	.92	2.30	2.30
.0042	0.05	.046	1.15	2.93	2.93
.0050	0.06	.055	1.38	3.48	3.48
.0056	0.07	.064	1.60	3.90	3.90
.0064	0.08	.074	1.85	4.46	4.46
.0071	0.09	.083	2.08	4.94	4.94
.0073	0.10	.093	2.33	5.09	5.09
.0074	0.11	.103	2.58	5.16	5.16
.0070	0.12	.113	2.83	4.88	4.88
.0056	0.13	.124	3.10	3.90	3.90
.0040	0.14	.136	3.40	2.79	2.79
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 28

Project
Code No's. T-116
Technician BPS
Date: Feb 11/56

Specimen	1161	1162
Test -- Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test -- Tension	x	x
Width ins.	1.00	1.00
Depth ins.	1.05	1.07
Cross-sect. Area sq.in	1.05	1.07
Unit Weight #/Cu.ft	141.5	139.2
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 30/56
Date Tested	Feb 11/56
Testing Temperature	75 °F
Accelerated Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	25 #Cap.

1161

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0025	0.01	.0075	.19	1.74	1.66
.0042	0.02	.016	.40	2.93	2.89
.0057	0.03	.024	.60	3.97	3.78
.0078	0.04	.032	.80	5.44	5.18
.0097	0.05	.040	1.00	6.76	6.44
.0114	0.06	.049	1.23	7.94	7.55
.0129	0.07	.057	1.43	8.91	8.49
.0145	0.08	.065	1.63	10.10	9.61
.0158	0.09	.074	1.85	11.01	10.50
.0169	0.10	.083	2.08	11.78	11.21
.0176	0.11	.092	2.30	12.28	11.69
.0179	0.12	.102	2.56	12.48	11.88
.0175	0.13	.113	2.83	12.18	11.60
.0154	0.14	.125	3.13	10.73	10.23
.0120	0.15	.138	3.45	8.36	7.96
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1162

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0027	0.01	.0073	.18	1.86	1.74
.0045	0.02	.015	.37	3.14	2.94
.0056	0.03	.025	.63	3.90	3.64
.0064	0.04	.034	.85	4.46	4.17
.0069	0.05	.043	1.08	4.81	4.50
.0058	0.06	.054	1.45	4.04	3.77
.0015	0.07	.069	1.73	1.05	0.98
.0010	0.08	.079	1.98	0.70	0.65
	0.09				
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet	29
Project	
Code No's.	T-210
Technician	BPS
Date:	Feb 11/56

Specimen	2101	2102
Test -- Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test -- Tension	x	x
Width ins.	1.00	1.00
Depth ins.	0.97	1.03
Cross-sect. Area sq.in	0.97	1.03
Unit Weight #/Cu.ft	140.3	139.8
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	–
Date Fabricated	Jan 25/56
Date Tested	Feb 11/56
Testing Temperature	75 °F
Accelerated Aging:	29 hrs. @140°F
Rate of Strain	0.08 in/min.
Proving Ring	25 #Cap.

2101

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0011	0.01	.0099	.25	.77	.79
.0016	0.02	.018	.45	1.11	1.15
.0019	0.03	.028	.70	1.32	1.36
.0019	0.04	.038	.95	1.32	1.36
.0019	0.05	.048	1.20	1.32	1.36
.0018	0.06	.058	1.45	1.25	1.29
.0012	0.07	.069	1.73	.83	0.85
	0.08				
	0.09				
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2102

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0011	0.01	.0099	.25	.77	.75
.0014	0.02	.019	.48	.98	.95
.0012	0.03	.029	.73	.83	.81
.0004	0.04	.040	1.00	.28	.27
	0.05				
	0.06				
	0.07				
	0.08				
	0.09				
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

Sheet 30

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Project:
Code No's: T-212
Technician: BPS
Date: Feb 11/56

Specimen	2121	2122
Test -- Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test -- Tension	x	x
Width ins.	0.98	1.10
Depth ins.	1.02	0.97
Cross-sect. Area sq.in	1.00	1.07
Unit Weight #/Cu.ft		
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 27/56
Date Tested	Feb 11/56
Testing Temperature	75 °F
Accelerated Aging:	29 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	25 #Cap.

# 2121						# 2122					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0005	0.01	.0095	.23	.35	.35	.0015	0.01	.0085	.21	1.04	.97
.0010	0.02	.019	.47	.70	.70	.0029	0.02	.017	.43	2.02	1.89
.0025	0.03	.027	.67	1.74	1.74	.0040	0.03	.026	.65	2.79	2.61
.0038	0.04	.036	.90	2.65	2.65	.0048	0.04	.035	.87	3.34	3.12
.0044	0.05	.046	1.15	3.06	3.06	.0052	0.05	.045	1.13	3.62	3.38
.0051	0.06	.055	1.38	3.56	3.56	.0052	0.06	.055	1.38	3.62	3.38
.0053	0.07	.065	1.63	3.69	3.69	.0049	0.07	.065	1.63	3.42	3.20
.0053	0.08	.075	1.88	3.69	3.69	.0040	0.08	.076	1.90	2.79	2.61
.0049	0.09	.085	2.13	3.41	3.41	.0030	0.09	.087	2.18	2.09	1.95
.0041	0.10	.096	2.40	2.86	2.86	.0020	0.10	.098	2.45	1.39	1.30
.0034	0.11	.107	2.68	2.37	2.37		0.11				
	0.12						0.12				
	0.13						0.13				
	0.14						0.14				
	0.15						0.15				
	0.16						0.16				
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 31

Project

Code No's: T-214

Technician BPS

Date: Feb 11/56

Specimen	2141	2142
Test -- Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test -- Tension	x	x
Width ins.	1.00	1.00
Depth ins.	0.99	0.97
Cross-sect. Area sq.in	0.99	0.97
Unit Weight #/Cu.ft	142.4	140.8
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 28/56
Date Tested	Feb 11/56
Testing Temperature	75 °F
Accelerated Aging:	29 hrs. @ 140F
Rate of Strain	0.08 in/min.
Proving Ring	25 #Cap.

#2141 Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	# 2142 Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0018	0.01	.0082	.20	1.25	1.26	.0027	0.01	.0073	.18	1.88	1.94
.0039	0.02	.016	.46	2.72	2.75	.0036	0.02	.016	.40	2.79	2.88
.0057	0.03	.024	.60	3.97	4.02	.0060	0.03	.024	.60	4.18	4.31
.0065	0.04	.033	.83	4.53	4.57	.0065	0.04	.034	.85	5.93	6.11
.0086	0.05	.041	1.05	5.99	6.05	.0042	0.05	.046	1.15	2.93	3.02
.0096	0.06	.050	1.25	6.69	6.75	.0012	0.06	.059	1.75	0.84	0.87
.0103	0.07	.060	1.50	7.18	7.25		0.07				
.0105	0.08	.070	1.75	7.31	7.39		0.08				
.0099	0.09	.080	2.00	6.90	6.97		0.09				
.0082	0.10	.092	2.30	5.71	5.78		0.10				
.0055	0.11	.104	2.60	3.83	3.87		0.11				
	0.12						0.12				
	0.13						0.13				
	0.14						0.14				
	0.15						0.15				
	0.16						0.16				
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

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Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 32

Project

Code No's. T-216

Technician BPS

Date: Feb 11/56

Specimen	2161	2162		
Test -- Compression			% Asphalt Cement	8.0
Length ins.			Type Asphalt Cement	Husky Pen 200-300
Diameter ins.			% Additive	6.0
Volume cc's			Type Additive	Polythene 119 Comm
Unit Weight #/cu.ft			Date Fabricated	Jan 30/56
Cross-sect. Area sq.in			Date Tested	Feb 11/56
Test -- Tension	x	x	Testing Temperature	75°F
Width ins.	1.00	1.00	Accelerated Aging:	29 hrs. @ 140°F
Depth ins.	1.06	1.07	Rate of Strain	.08 in/min.
Cross-sect. Area sq.in	1.06	1.07	Proving Ring	25 #Cap.
Unit Weight #/Cu.ft	140.0	140.5		
Volume cc's				

# 2161						# 2162					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0018	0.01	.0082	.20	1.25	1.18	.0028	0.01	.0072	.18	1.95	1.82
.0036	0.02	.016	.40	2.51	2.37	.0051	0.02	.015	.37	2.58	2.41
.0043	0.03	.026	.65	3.00	2.83	.0078	0.03	.022	.55	5.43	5.07
.0041	0.04	.036	.90	2.86	2.70	.0098	0.04	.030	.75	5.83	6.83
.0030	0.05	.047	1.18	2.09	1.97	.0123	0.05	.038	.95	8.56	8.00
.0010	0.06	.059	1.47	0.70	0.66	.0140	0.06	.046	1.15	9.75	9.10
.0002	0.07	.068	1.70	0.14	0.14	.0155	0.07	.054	1.35	10.80	10.15
	0.08					.0157	0.08	.064	1.60	10.94	10.23
	0.09					.0100	0.09	.080	2.00	6.97	6.51
	0.10					.0018	0.10	.098	2.45	1.26	1.18
	0.11						0.11				
	0.12						0.12				
	0.13						0.13				
	0.14						0.14				
	0.15						0.15				
	0.16						0.16				
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

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Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 33

Project
Code No's. T-310
Technician BPS
Date: Feb 11/56

Specimen		3101	3102
Test -- Compression			
Length	Ins.		
Diameter	Ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.In		
Test -- Tension		x	x
Width	Ins.	1.00	1.06
Depth	Ins.	1.01	0.98
Cross-sect. Area	sq.In	1.01	1.04
Unit Weight	#/Cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	-
Date Fabricated	Jan 26/56
Date Tested	Feb 11/56
Testing Temperature	75 °F
Accelerated Aging:	70 hrs. @140°F
Rate of Strain	0.08 in/min.
Proving Ring	25 #Cap.

#3101

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0017	0.01	.0083	.21	1.19	1.18
.0033	0.02	.017	.43	2.30	2.28
.0049	0.03	.025	.62	3.42	3.39
.0066	0.04	.033	.82	4.60	4.55
.0077	0.05	.042	1.05	5.36	5.31
.0084	0.06	.052	1.30	5.85	5.79
.0087	0.07	.061	1.53	6.06	6.00
.0084	0.08	.072	1.80	5.85	5.79
.0066	0.09	.083	2.08	4.60	4.55
.0038	0.10	.096	2.40	2.65	2.62
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3102

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0017	0.01	.0083	.21	1.19	1.14
.0027	0.02	.017	.42	1.88	1.81
.0033	0.03	.027	.67	2.30	2.21
.0039	0.04	.036	.90	2.72	2.62
.0044	0.05	.046	1.15	3.06	2.94
.0046	0.06	.055	1.38	3.21	3.08
.0047	0.07	.065	1.63	3.28	3.15
.0044	0.08	.076	1.90	3.06	2.94
.0039	0.09	.086	2.15	2.72	2.61
.0032	0.10	.097	2.42	2.23	2.14
.0024	0.11	.108	2.73	1.67	1.61
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

University of Alberta

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 34

Project

Code No's. T-312

Technician BPS

Date: Feb 11/56

Specimen	3121	3122
Test -- Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test -- Tension	x	x
Width ins.	1.00	1.12
Depth ins.	1.04	0.96
Cross-sect. Area sq.in	1.04	1.08
Unit Weight #/cu.ft	139.7	139.4
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 27/56
Date Tested	Feb 11/56
Testing Temperature	75 °F
Accelerated Aging:	70 hrs. @ 70 °F
Rate of Strain	0.08 in/min.
Proving Ring	25 #Cap.

3121

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0010	0.01	.0090	.23	.70	0.67
.0026	0.02	.017	.43	1.82	1.75
.0032	0.03	.027	.68	2.23	2.14
.0042	0.04	.036	.90	2.92	2.81
.0055	0.05	.045	1.13	3.83	3.68
.0071	0.06	.053	1.33	4.94	4.74
.0082	0.07	.062	1.55	5.71	5.49
.0091	0.08	.071	1.77	6.34	6.09
.0097	0.09	.080	2.00	6.76	6.50
.0099	0.10	.090	2.35	6.89	6.62
.0096	0.11	.101	2.53	6.69	6.42
.0083	0.12	.112	2.80	5.78	5.56
.0069	0.13	.123	3.08	4.81	4.63
.0049	0.14	.135	2.38	3.42	3.29
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3122

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0018	0.01	.0082	.20	1.25	1.16
.0027	0.02	.017	.43	1.88	1.74
.0049	0.03	.025	.63	3.42	3.17
.0059	0.04	.034	.85	4.11	3.81
.0069	0.05	.043	1.07	4.81	4.45
.0073	0.06	.053	1.33	5.09	4.71
.0077	0.07	.062	1.55	5.36	4.96
.0077	0.08	.072	1.80	5.36	4.92
.0072	0.09	.083	2.08	5.02	4.65
.0064	0.10	.094	2.36	4.46	4.14
.0051	0.11	.105	2.63	3.55	3.29
.0039	0.12	.116	2.90	2.72	2.52
.0026	0.13	.127	3.18	1.81	1.68
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

University of Alberta Dept. of Civil Engineering ASPHALT ADMIXTURE INVESTIGATION	Sheet 35 Project Case No's. T-314 Technician BPS Date: Feb 11/56

Specimen		3141	3142
Test -- Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.in		
Test -- Tension		x	x
Width	ins.	1.00	1.00
Depth	ins.	1.03	1.01
Cross-sect. Area	sq.in	1.03	1.01
Unit Weight	#/cu.ft	141.6	141.0
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 29/56
Date Tested	Feb 11/56
Testing Temperature	75 °F
Accelerated Aging:	70 hrs. @ 140F
Rate of Strain	0.08 in/min.
Proving Ring	25 #Cap.

# 3141						# 3142					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0020	0.01	.0080	.20	1.39	1.35	.0023	0.01	.0077	.19	1.60	1.58
.0043	0.02	.016	.40	3.00	2.91	.0039	0.02	.016	.40	2.72	2.70
.0070	0.03	.023	..57	4.88	4.74	.0060	0.03	.024	.60	4.18	4.14
.0092	0.04	.031	.77	6.41	6.23	.0080	0.04	.032	.80	5.57	5.53
.0115	0.05	.039	.98	8.01	7.77	.0097	0.05	.040	1.00	6.76	6.69
.0135	0.06	.046	1.15	9.41	9.14	.0106	0.06	.050	1.25	7.38	7.30
.0158	0.07	.054	1.35	11.00	10.68	.0109	0.07	.059	1.48	7.59	7.50
.0173	0.08	.063	1.57	12.07	11.70	.0092	0.08	.071	1.78	6.41	6.35
.0185	0.09	.071	1.78	12.88	12.48	.0040	0.09	.086	2.15	2.79	2.76
.0190	0.10	.081	2.03	13.24	12.87		0.10				
.0180	0.11	.092	2.30	12.53	12.18		0.11				
.0090	0.12	.111	2.78	6.26	6.08		0.12				
	0.13						0.13				
	0.14						0.14				
	0.15						0.15				
	0.16						0.16				
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

Sheet 36

University of Alberta

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Project	
Code No's.	T-316
Technician	BPS
Date:	Feb 11/56

Specimen	3161	3162
Test -- Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test -- Tension	x	x
Width ins.	1.00	1.00
Depth ins.	1.02	1.01
Cross-sect. Area sq.in	1.02	1.01
Unit Weight #/Cu.ft	139.0	138.2
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 30/56
Date Tested	Feb 11/56
Testing Temperature	75 °F
Accelerated Aging:	70 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	25 #Cap.

3161

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0025	0.01	.0075	.19	1.74	1.71
.0050	0.02	.015	.38	3.48	3.41
.0078	0.03	.022	.55	5.44	5.33
.0097	0.04	.030	.75	6.76	6.63
.0116	0.05	.038	.95	8.08	7.92
.0124	0.06	.048	1.20	8.64	8.46
.0126	0.07	.057	1.43	8.79	8.60
.0120	0.08	.068	1.70	8.36	8.20
.0102	0.09	.080	2.00	7.11	6.98
.0076	0.10	.092	2.30	5.29	5.19
.0050	0.11	.105	2.63	3.48	3.41
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3162

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0025	0.01	.0075	.19	1.74	1.71
.0053	0.02	.015	.37	3.70	3.62
.0075	0.03	.022	.55	5.23	5.13
.0092	0.04	.031	.77	6.41	6.29
.0102	0.05	.040	1.00	7.11	6.97
.0104	0.06	.050	1.25	7.25	7.10
.0082	0.07	.062	1.55	5.71	5.60
.0057	0.08	.074	1.85	3.97	3.89
.0032	0.09	.087	2.18	2.23	2.19
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 37

Project	
Code No's.	T-120
Technician	BPS
Date:	Feb 12/56

Specimen		1201	1202
Test -- Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.in		
Test -- Tension		x	x
Width	ins.	1.00	1.00
Depth	ins.	0.89	1.03
Cross-sect. Area	sq.in	0.89	1.03
Unit Weight	#/Cu.ft	142.8	142.1
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	-
Date Fabricated	Jan 25/56
Date Tested	Feb 12/56
Testing Temperature	10 °F
Accelerated Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	400 #Cap.

1201

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0002	0.01	.0098	.25	1.6	1.8
.0008	0.02	.0192	.48	6.3	7.1
.0017	0.03	.028	.70	13.3	15.0
.0035	0.04	.036	.90	27.4	30.8
.0056	0.05	.044	1.10	44.0	49.4
.0083	0.06	.052	1.30	65.1	73.1
.0118	0.07	.058	1.45	92.5	104.0
.0145	0.08	.065	1.63	113.8	128.8
.0173	0.09	.073	1.83	135.8	152.7
.0196	0.10	.080	2.00	153.8	173.0
.0230	0.11	.087	2.18	180.5	203.0
.0270	0.12	.093	2.32	212.0	238.5
.0298	0.13	.100	2.50	234.0	252.0
.0325	0.14	.107	2.68	255.0	287.0
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1202

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0014	0.01	.0086	.21	11.0	10.7
.0032	0.02	.017	.43	25.1	24.3
.0060	0.03	.024	.60	47.0	45.6
.0083	0.04	.032	.80	65.1	64.1
.0091	0.05	.041	1.05	71.4	69.3
.0140	0.06	.046	1.15	109.8	106.7
	0.07				
	0.08				
	0.09				
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 38

Project

Code No's. T-122

Technician BPS

Date: Feb 12/56

Specimen		1221	1222
Test -- Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.in		
Test -- Tension		x	x
Width	ins.	1.00	1.07
Depth	ins.	1.03	0.967
Cross-sect. Area	sq.in	1.03	1.03
Unit Weight	#/Cu.ft	139.6	138.6
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 27/56
Date Tested	Feb 12/56
Testing Temperature	10 °F
Accelerated Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

1221

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0008	0.01	.0092	.23	11.0	10.7
.0024	0.02	.018	.45	32.9	31.9
.0049	0.03	.025	.63	67.2	65.2
.0073	0.04	.033	.82	100.0	97.0
.0098	0.05	.040	1.00	134.5	130.5
.0128	0.06	.047	1.18	175.6	170.5
.0160	0.07	.054	1.35	319.5	213.3
.0197	0.08	.060	1.50	270.5	262.5
.0234	0.09	.067	1.68	321.2	311.5
.0260	0.10	.074	1.85	356.5	348.0
.0299	0.11	.080	2.00	410.1	398.3
.0331	0.12	.087	2.18	454.5	430.5
.0365	0.13	.093	2.33	500.2	486.0
.0394	0.14	.100	2.50	540.0	524.0
.0434	0.15	.107	2.68	595.0	577.0
.0455	0.16	.115	2.88	624.0	605.0
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1222

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0015	0.01	.0085	.21	20.6	20.0
.0029	0.02	.017	.42	39.75	38.55
.0050	0.03	.025	.62	68.55	66.5
.0071	0.04	.033	.82	97.4	94.5
.0090	0.05	.041	1.02	123.3	119.8
.0111	0.06	.049	1.22	152.3	147.8
.0130	0.07	.057	1.43	178.4	173.3
.0149	0.08	.065	1.63	204.5	198.5
.0158	0.09	.073	1.83	217.0	210.5
.0156	0.10	.084	2.10	214.0	207.5
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 39

Project	
Code No's.	T-124
Technician	BPS
Date:	Feb 12/56

Specimen	1241	1242
Test -- Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test -- Tension	x	x
Width ins.	1.00	1.00
Depth ins.	1.00	1.00
Cross-sect. Area sq.in	1.00	1.00
Unit Weight #/Cu.ft	140.8	140.5
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 27/56
Date Tested	Feb 12/56
Testing Temperature	10 °F
Accelerated Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

1241

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0026	0.01	.0074	.19	35.6	35.6
.0047	0.02	.015	.37	64.5	64.5
.0055	0.03	.024	.60	75.4	75.4
.0090	0.04	.031	.78	123.5	123.5
.0126	0.05	.037	.92	172.8	172.8
.0154	0.06	.045	1.13	211.5	211.5
.0172	0.07	.053	1.33	236.0	236.0
.0200	0.08	.060	1.50	274.5	274.5
.0256	0.09	.064	1.60	351.0	351.0
.0300	0.10	.070	1.75	411.0	411.0
.0370	0.11	.073	1.83	507.0	507.0
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1242

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0006	0.01	.0094	.24	8.2	8.2
.0026	0.02	.017	.43	35.6	35.6
.0044	0.03	.026	.65	60.3	60.3
.0056	0.04	.034	.85	76.8	76.8
.0060	0.05	.044	1.10	82.2	82.2
.0060	0.06	.054	1.35	82.2	82.2
.0080	0.07	.062	1.55	109.7	109.7
.0150	0.08	.065	1.63	205.5	205.5
.0162	0.09	.074	1.85	212.2	212.2
.0180	0.10	.082	2.05	247.0	247.0
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 40

Project

Code No's. T-126

Technician BPS

Date: Feb 18/56

Specimen	1261	1262
Test -- Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test -- Tension	x	x
Width ins.	1.00	1.00
Depth ins.	1.05	1.06
Cross-sect. Area sq.in	1.05	1.06
Unit Weight #/Cu.ft	139.5	139.5
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 30/56
Date Tested	Feb 18/56
Testing Temperature	10 °F
Accelerated Agings	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

1261

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0022	0.01	.0078	.20	30.2	28.8
.0047	0.02	.015	.38	64.4	61.3
.0071	0.03	.023	.58	97.3	92.6
.0095	0.04	.030	.75	130.2	124.0
.0115	0.05	.039	.98	157.8	150.2
.0119	0.06	.048	1.20	163.2	155.6
	0.07				
	0.08				
	0.09				
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1262

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0014	0.01	.0086	.21	19.2	18.1
.0035	0.02	.017	.42	48.0	45.3
.0060	0.03	.024	.60	82.3	77.6
.0098	0.04	.030	.75	134.3	126.8
.0141	0.05	.036	.90	193.5	182.6
.0185	0.06	.041	1.03	254.0	239.5
.0215	0.07	.048	1.20	294.7	278.5
.0239	0.08	.056	1.40	328.0	309.0
.0245	0.09	.065	1.63	336.0	316.5
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 41

Project

Core No's. T-220

Technician BPS

Date: Feb 18/56

Specimen		2201	2202
Test -- Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.in		
Test -- Tension		x	x
Width	ins.	1.00	1.00
Depth	ins.	1.03	0.99
Cross-sect. Area	sq.in	1.03	0.99
Unit Weight	#/cu.ft	140.2	139.9
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	-
Date Fabricated	Jan 25/56
Date Tested	Feb 18/56
Testing Temperature	10 °F
Accelerated Aging:	29 hrs. @140°F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

# 2201						# 2202					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0007	0.01	.0093	.23	9.6	9.3	.0018	0.01	.0082	.21	24.7	25.0
.0016	0.02	.018	.45	22.0	21.4	.0039	0.02	.016	.40	53.5	54.0
.0047	0.03	.025	.62	64.5	62.6	.0060	0.03	.024	.60	82.3	83.1
.0074	0.04	.033	.83	101.5	98.5	.0070	0.04	.033	.83	96.0	97.0
.0101	0.05	.040	1.00	138.5	134.5	.0080	0.05	.042	1.05	109.7	110.9
.0131	0.06	.047	1.18	179.8	174.5	.0097	0.06	.050	1.25	133.0	134.3
.0159	0.07	.054	1.35	218.3	212.0	.0129	0.07	.057	1.43	177.0	178.7
.0182	0.08	.062	1.55	249.8	244.2	.0158	0.08	.064	1.60	216.8	218.8
.0192	0.09	.071	1.77	263.5	256.0	.0162	0.09	.074	1.85	222.5	225.5
	0.10						0.10				
	0.11						0.11				
	0.12						0.12				
	0.13						0.13				
	0.14						0.14				
	0.15						0.15				
	0.16						0.16				
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

[illegible]

University of Illinois

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet: 42

Project

Code No's.: T-222

Technician: BPS

Date: Feb 18/56

Specimen	2221	2222
Test -- Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test -- Tension	x	x
Width ins.	1.00	1.07
Depth ins.	1.02	0.94
Cross-sect. Area sq.in	1.02	1.00
Unit Weight #/Cu.ft	140.4	139.3
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 27/56
Date Tested	Feb 18/56
Testing Temperature	10 °F
Accelerated Aging:	29 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

# 2221						# 2222					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0012	0.01	.0088	.22	16.5	16.2	.0029	0.01	.0071	.18	39.8	39.8
.0034	0.02	.017	.43	46.6	35.7	.0035.017	0.02	.017	.43	48.0	48.0
.0068	0.03	.023	.58	93.2	91.3	.0070	0.03	.023	.58	95.9	95.9
.0101	0.04	.030	.75	138.5	135.9	.0120	0.04	.028	.70	164.6	164.6
.0147	0.05	.035	.88	201.8	197.5	.0153	0.05	.035	.88	210.0	210.0
.0181	0.06	.042	1.05	248.2	243.5	.0183	0.06	.042	1.05	251.0	251.0
.0209	0.07	.049	1.23	286.5	281.0	.0210	0.07	.049	1.23	288.0	288.0
.0218	0.08	.058	1.45	299.0	293.0	.0217	0.08	.058	1.45	298.0	298.0
	0.09						0.09				
	0.10						0.10				
	0.11						0.11				
	0.12						0.12				
	0.13						0.13				
	0.14						0.14				
	0.15						0.15				
	0.16						0.16				
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

[illegible]

University of Alberta

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 43

Program:

Code data: T-224

Technician: BPS

Date: Feb 18/56

Specimen	2241	2242		
Test -- Compression			% Asphalt Cement	8.0
Length ins.			Type Asphalt Cement	Husky Pen 200-300
Diameter ins.			% Additive	4.0
Volume cc's			Type Additive	Polythene 119 Comm
Unit Weight #/cu.ft			Date Fabricated	Jan 28/56
Cross-sect. Area sq.in			Date Tested	Feb 18/56
Test -- Tension	xv	x	Testing Temperature	10 °F
Width ins.	1.00	1.00	Accelerated Aging:	29 hrs. @ 140°F
Depth ins.	1.01	0.96	Rate of Strain	0.08 in/min.
Cross-sect. Area sq.in	1.01	0.96	Proving Ring	600 #Cap.
Unit Weight #/Cu ft	140.2	142.4		
Volume cc's				

2241

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0008	0.01	.0092	.23	10.0	9.9
.0011	0.02	.019	.48	15.1	15.0
.0028	0.03	.027	.68	38.4	38.1
.0043	0.04	.036	.90	59.0	58.4
.0070	0.05	.043	1.07	95.9	94.9
.0106	0.06	.049	1.23	145.2	143.8
.0140	0.07	.056	1.40	192.0	190.0
.0180	0.08	.062	1.55	245.0	242.5
.0223	0.09	.068	1.70	306.0	302.9
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2242

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0018	0.01	.0082	.21	24.7	25.8
.0048	0.02	.015	.37	65.8	68.6
.0085	0.03	.021	.53	116.6	121.5
.0107	0.04	.029	.72	146.8	153.0
.0159	0.05	.034	.85	218.0	227.5
.0184	0.06	.042	1.05	252.5	242.5
.0192	0.07	.051	1.27	263.5	275.0
.0209	0.08	.059	1.48	286.8	301.5
	0.09				
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

[illegible]

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 44

Project:

Code No's.: T-226

Technician: BPS

Date: Feb 18/56

Specimen		2261	2262
Test -- Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.in		
Test -- Tension		x	x
Width	ins.	1.00	1.00
Depth	ins.	1.04	1.06
Cross-sect. Area	sq.in	1.04	1.06
Unit Weight	#/cu.ft	141.0	141.0
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 30/56
Date Tested	Feb 18/56
Testing Temperature	10 °F
Accelerated Aging:	29 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

2261

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0032	0.01	.0068	.17	43.9	42.1
.0065	0.02	.013	.32	89.1	85.6
.0088	0.03	.021	.53	120.8	116.0
.0105	0.04	.029	.73	144.0	138.3
.0120	0.05	.038	.95	164.7	158.2
.0129	0.06	.047	1.18	177.0	170.1
.0135	0.07	.056	1.40	185.3	178.1
.0130	0.08	.067	1.68	178.4	171.5
.0105	0.09	.079	1.98	157.8	151.8
.0040	0.10	.096	2.40	54.9	52.7
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2262

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0013	0.01	.0087	.22	17.8	16.8
.0034	0.02	.017	.43	46.6	44.0
.0070	0.03	.023	.58	95.9	90.4
.0102	0.04	.030	.75	140.0	132.0
.0137	0.05	.036	.90	188.0	177.3
.0175	0.06	.042	1.05	240.0	226.5
.0205	0.07	.049	1.23	281.0	265.0
.0220	0.08	.058	1.45	302.0	285.0
	0.09				
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 45

Project	
Case No's.	T-330
Technician	LPS
Date	Feb 18/56

Specimen	3201	3202
Test -- Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test -- Tension	x	x
Width ins.	1.00	1.04
Depth ins.	1.02	0.96
Cross-sect. Area sq.in	1.02	1.00
Unit Weight #/Cu.ft	139.6	139.1
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	-
Date Fabricated	Jan 26/56
Date Tested	Feb 18/56
Testing Temperature	10 °F
Accelerated Aging:	70 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

3201

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0009	0.01	.0091	.23	12.3	12.1
.0026	0.02	.017	.43	35.6	34.9
.0054	0.03	.025	.63	74.1	72.6
.0083	0.04	.032	.80	113.9	111.7
.0109	0.05	.039	.98	149.5	146.5
.0135	0.06	.046	1.15	185.2	181.7
.0163	0.07	.054	1.35	224.0	219.5
.0180	0.08	.062	1.55	247.0	242.0
.0189	0.09	.071	1.78	259.5	254.5
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3201

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0029	0.01	.0071	.18	39.8	39.8
.0051	0.02	.015	.37	69.9	69.9
.0070	0.03	.023	.58	96.0	96.0
.0102	0.04	.030	.75	140.0	140.0
.0135	0.05	.034	.85	185.1	185.1
.0160	0.06	.044	1.10	219.5	219.5
.0182	0.07	.052	1.30	250.0	250.0
.0190	0.08	.061	1.53	260.5	260.5
	0.09				
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Code No.	T-322
Technician	BPS
Date	Feb 18/56

Specimen		3221	3222
Test -- Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.in		
Test -- Tension		x	x
Width	ins.	1.00	1.06
Depth	ins.	1.04	0.97
Cross-sect. Area	sq.in	1.04	1.03
Unit Weight	#/Cu.ft	139.5	139.7
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 27/56
Date Tested	Feb 18/56
Testing Temperature	10 °F
Accelerated Aging:	70 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

3221

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0007	0.01	.0092	.23	9.6	9.2
.0018	0.02	.018	.45	24.7	23.7
.0033	0.03	.027	.67	45.2	43.4
.0052	0.04	.035	.87	71.3	68.5
.0083	0.05	.042	1.05	113.8	109.3
.0115	0.06	.048	1.20	157.8	151.8
.0150	0.07	.055	1.38	206.0	198.0
.0185	0.08	.061	1.53	264.0	244.0
.0211	0.09	.069	1.73	289.5	278.5
.0235	0.10	.077	1.93	322.5	311.0
.0248	0.11	.085	2.13	340.0	326.5
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3222

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0011	0.01	.0089	.22	15.1	14.7
.0018	0.02	.018	.45	24.7	24.0
.0028	0.03	.027	.68	38.4	37.3
.0042	0.04	.036	.90	57.6	55.9
.0058	0.05	.044	1.10	79.5	77.1
.0083	0.06	.052	1.30	113.9	110.5
.0108	0.07	.059	1.48	148.2	144.0
.0128	0.08	.067	1.68	175.8	170.8
.0154	0.09	.075	1.88	211.3	205.5
.0176	0.10	.082	2.05	241.5	234.5
.0192	0.11	.091	2.28	263.5	255.5
.0201	0.12	.100	2.50	276.0	268.0
.0210	0.13	.109	2.73	288.3	280.1
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

Sheet 47

Dept. of Civil Engineering

Asphalt Mixture Investigation

Project	
Code No.	T-324
Technician	BPS
Date	Feb 18/56

Specimen	3241	3242
Test — Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test — Tension	x	x
Width ins.	1.00	1.00
Depth ins.	0.99	1.01
Cross-sect. Area sq.in	0.99	1.01
Unit Weight #/cu.ft	140.8	140.3
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 29/56
Date Tested	Feb 18/56
Testing Temperature	10 °F
Accelerated Aging:	70 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

3241

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0021	0.01	.0079	.20	28.8	29.1
.0048	0.02	.015	.37	65.8	66.5
.0087	0.03	.021	.53	119.3	120.7
.0118	0.04	.028	.70	161.8	163.5
.0152	0.05	.035	.88	208.5	210.7
.0170	0.06	.043	1.08	233.5	236.0
	0.07				
	0.08				
	0.09				
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3242

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0017	0.01	.0083	.21	23.4	23.2
.0043	0.02	.016	.40	59.0	58.4
.0072	0.03	.023	.57	98.6	97.5
.0105	0.04	.029	.73	144.0	142.5
.0135	0.05	.036	.90	185.1	183.4
.0165	0.06	.043	1.08	226.5	224.4
.0185	0.07	.051	1.28	254.0	251.5
	0.08				
	0.09				
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

[illegible]

[illegible]

Project:		
Case No.:	T-326	
Technician:	BPS	
Date:	Feb 16/56	

Specimen		3261	3262
Test -- Compression			
Length	Ins.		
Diameter	Ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.in		
Test -- Tension		x	x
Width	Ins.	1.00	1.00
Depth	Ins.	1.05	1.02
Cross-sect. Area	sq.in	1.05	1.02
Unit Weight	#/Cu.ft	139.5	138.9
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 31/56
Date Tested	Feb 18/56
Testing Temperature	10 °F
Accelerated Aging:	70 hrs. @140°F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

# 3261						# 3262					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0020	0.01	.0080	.20	27.4	26.1	.0021	0.01	.0079	.20	28.8	28.2
.0047	0.02	.015	.38	64.5	61.4	.0047	0.02	.015	.38	64.4	63.0
.0083	0.03	.022	.55	113.8	108.2	.0070	0.03	.023	.58	96.0	94.0
.0108	0.04	.029	.73	148.1	146.0	.0100	0.04	.030	.75	137.2	134.5
.0148	0.05	.035	.88	203.0	193.2	.0140	0.05	.036	.90	192.0	188.1
.0184	0.06	.041	1.03	252.5	240.5	.0181	0.06	.042	1.05	248.5	243.5
.0225	0.07	.047	1.18	309.0	294.5	.0225	0.07	.047	1.18	308.5	303.0
.0260	0.08	.054	1.35	356.2	339.5	.0250	0.08	.055	1.38	343.0	336.0
.0290	0.09	.061	1.53	397.5	378.0		0.09				
.0315	0.10	.068	1.70	431.5	410.5		0.10				
.0317	0.11	.078	1.95	434.5	413.5		0.11				
	0.12						0.12				
	0.13						0.13				
	0.14						0.14				
	0.15						0.15				
	0.16						0.16				
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

University of Georgia
Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 49

Project
Code No.: C-120
Technician BPS
Date: Feb 18/56

Specimen

Test — Compression		% Asphalt	8.0
Length Ins.		Type Asphalt	Husky Pen 200-300
Diameter Ins.		% Additive	0
Volume cc's		Type Additive	--
Unit Weight #/cu.ft.		Date Fabric.	Jan 18/56
Cross-sect. Area sq.Ins.		Date Tested	Feb 18/56
Test — Tension		Testing Temperature	10
Width Ins.		Accelerated Aging	0 -
Depth Ins.		Rate of Strain	0.08
Cross-sect. Area sq.Ins.		Proving Ring	10,000
Unit Weight #/cu.ft.			
Volume cc's			

#1201

Proving Ring	Def. Dial	True Def.	% Str.	Load #	Stress psi
.0000	0.00				
.0020	0.01	.0098	.23	280	89.2
.0043	0.02	.016	.37	620	197.6
.0065	0.03	.023	.47	920	293
.0084	0.04	.032	.76	1180	386
.0097	0.05	.040	.95	1360	433
.0107	0.06	.049	1.08	1495	476
.0112	0.07	.059	1.41	1570	500
.0114	0.08	.069	1.65	1600	519
.0112	0.09	.079	1.88	1570	500
.0108	0.10	.089	2.12	1500	478
.0105	0.11	.099	2.36	1470	468
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

#1202

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0004	0.01	.0096	.23	60	19.1
.0011	0.02	.019	.45	125	39.8
.0034	0.03	.026	.62	485	151
.0068	0.04	.033	.79	960	306
.0099	0.05	.041	.98	1390	443
.0119	0.06	.048	1.14	1650	526
.0135	0.07	.056	1.33	.825	581
.0153	0.08	.065	1.55	2150	685
.0165	0.09	.073	1.74	2310	736
.0173	0.10	.083	1.98	2420	771
.0178	0.11	.092	2.19	2500	796
.0183	0.12	.102	2.43	2555	814
.0185	0.13	.111	2.64	2580	821
.0185	0.14	.120	2.86	2580	821
.0185	0.15	.130	3.12	2580	821
.0184	0.16	.141	3.36	2575	819
.0181	0.17	.151	3.60	2520	803
.0179	0.18	.162	3.86	2505	797
.0178	0.19	.172	4.10	2500	796
.0177	0.20	.182	4.34	2495	795
.0175	0.21	.192	4.58	2450	780
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

University of Alberta
Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 50

Project

Code No.: C-122

Technician: BPS

Date: Feb 18/56

Specimen				
Test -- Compression	x	x	% Asphalt	8.0
Length ins.	4.13	4.04	Type Asphalt	Husky Pen 200-300
Diameter ins.	2.00	2.00	% Additive	2.0
Volume cc's	212.6	208.0	Type Additive	Polythene 119 Comm
Unit Weight #/cu.ft.	140.6	138.4	Date Fabric.	Jan 20/56
Cross-sect. Area sq.ins.	3.14	3.14	Date Tested	Feb 18/56
Test -- Tension			Testing Temperature	10
Width ins.			Accelerated Aging	0 hrs. -
Depth ins.			Rate of Strain	0.08 in/min
Cross-sect. Area sq.ins.			Proving Ring	10,000 lbs
Unit Weight #/cu.ft.				
Volume cc's				

1221

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0005	0.01	.0095	.23	65	20.7
.0020	0.02	.018	.44	280	89.1
.0044	0.03	.026	.63	625	199
.0066	0.04	.034	.82	750	239
.0082	0.05	.042	1.03	1150	366
.0096	0.06	.050	1.21	1355	432
.0107	0.07	.059	1.43	1495	476
.0113	0.08	.069	1.67	1585	505
.0115	0.09	.079	1.92	1605	512
.0118	0.10	.088	2.13	1645	524
.0115	0.11	.098	2.38	1605	512
.0113	0.12	.109	2.64	1585	505
.0111	0.13	.119	2.88	1540	491
.0108	0.14	.129	3.13	1500	478
.0103	0.15	.140	3.39	1442	459
.0102	0.16	.150	3.63	1428	450
.0099	0.17	.160	3.88	1388	442
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1227

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0018	0.01	.0082	.20	265	84.4
.0050	0.02	.015	.36	700	223
.0085	0.03	.021	.51	1200	382
.0103	0.04	.030	.73	1440	459
.0132	0.05	.037	.89	1800	573
.0145	0.06	.045	1.09	2070	660
.0160	0.07	.054	1.31	2240	713
.0168	0.08	.063	1.53	2350	748
.0174	0.09	.073	1.77	2440	776
.0177	0.10	.082	1.98	2455	814
.0177	0.11	.092	2.21	2455	814
.0176	0.12	.102	2.48	2440	776
.0173	0.13	.113	2.74	2415	769
.0171	0.14	.122	2.96	2390	762
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Project:
Code No.: C-124
Technician: BPS
Date: Feb 18/56

Specimen	1241	1242
Test — Compression	x	x
Length ins.	4.17	4.21
Diameter ins.	2.00	2.00
Volume cc's	214.7	216.7
Unit Weight #/cu ft	143.2	139.5
Cross-sect. Area sq. ins.		
Test — Tension		
Width ins		
Depth ins		
Cross-sect. Area sq. ins		
Unit Weight #/cu ft		
Volume cc		

% Asphalt Cr	8.0
Type Asphalt	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabric.	Jan 21/56
Date Tested	Feb 18/56
Testing Temp.	10
Accelerated Curing	0 -
Rate of Strain	0.08
Proving Ring	10,000

1241

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0017	0.01	.0083	.20	238	76
.0048	0.02	.015	.36	671	224
.0085	0.03	.021	.50	1175	364
.0115	0.04	.028	.67	1610	513
.0148	0.05	.035	.84	2070	660
.0173	0.06	.043	1.03	2420	771
.0192	0.07	.051	1.22	2680	858
.0206	0.08	.059	1.39	2880	917
.0217	0.09	.068	1.63	3035	966
.0223	0.10	.078	1.87	3115	992
.0226	0.11	.087	2.09	3155	1010
.0225	0.12	.097	2.33	3145	1005
.0223	0.13	.108	2.59	3115	992
.0219	0.14	.118	2.83	3060	975
.0213	0.15	.129	3.10	2975	946
.0209	0.16	.139	3.34	2920	930
.0204	0.17	.150	3.60	2850	909
.0201	0.18	.160	3.84	2810	895
.0199	0.19	.170	4.08	2780	885
.0198	0.20	.180	4.31	2770	882

1242

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0025	0.01	.0075	.18	350	112
.0061	0.02	.014	.33	854	272
.0105	0.03	.020	.48	1470	468
.0137	0.04	.026	.62	1918	611
.0165	0.05	.033	.78	2310	736
.0183	0.06	.042	.99	2585	824
.0197	0.07	.051	1.21	2860	911
.0205	0.08	.059	1.38	2870	914
.0207	0.09	.069	1.64	2895	922
.0206	0.10	.079	1.86	2885	919
.0203	0.11	.089	2.12	2840	904
.0202	0.12	.098	2.33	2830	902
.0197	0.13	.110	2.52	2760	879
.0196	0.14	.120	2.85	2745	875
.0195	0.15	.130	3.09	2730	869

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 52

Project

Code Nos. C-126

Technician BPS

Date: Feb 18/56

Specimen	1261	1262
Test -- Compression	x	x
Length Ins.	4.08m	4.04
Diameter Ins.	2.00	2.00
Volume cc's	210.0	208.0
Unit Weight #/cu. ft.	139.8	139.7
Cross-sect. Area sq. ins.	3.14	3.14
Test -- Tension		
Width Ins.		
Depth Ins.		
Cross-sect. Area sq. ins.		
Unit Weight #/cu. ft.		
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 23/56
Date Tested	Feb 18/56
Testing Temperature	10
Accelerated Aging	0 Hrs. --
Rate of Strain	0.08 in/min
Proving Ring	10,000 # Cap.

#1261						# 1262					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0035	0.01	.0065	.16	490	157	.0032	0.01	.0068	.17	448	143
.0088	0.02	.011	.27	1232	393	.0072	0.02	.013	.32	1008	321
.0134	0.03	.017	.42	1875	597	.0105	0.03	.020	.49	1470	468
.0170	0.04	.023	.56	2380	758	.0135	0.04	.026	.64	1890	602
.0200	0.05	.030	.73	2800	892	.0162	0.05	.034	.84	2270	724
.0220	0.06	.038	.93	3080	981	.0178	0.06	.042	1.04	2495	795
.0234	0.07	.047	1.15	3130	997	.0191	0.07	.051	1.26	2675	853
.0241	0.08	.056	1.37	3370	1074	.0195	0.08	.061	1.51	2730	870
.0243	0.09	.066	1.62	3400	1083	.0196	0.09	.071	1.76	2745	874
.0241	0.10	.076	1.86	3370	1074	.0193	0.10	.081	2.01	2705	862
.0235	0.11	.086	2.11	3290	1048	.0192	0.11	.091	2.26	2690	857
.0227	0.12	.097	2.39	3175	1025	.0190	0.12	.101	2.50	2660	854
.0218	0.13	.109	2.67	3070	968	.0189	0.13	.111	2.75	2645	843
.0209	0.14	.119	2.92	2925	932	.0189	0.14	.121	3.00	2645	843
	0.15					.0188	0.15	.131	3.22	2635	839
	0.16						0.16				
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

Sheet 53

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Project	
Code No's.	C-220
Technician	BPS
Date:	Feb 18/56

Specimen		2201	
Test -- Compression		x	
Length	ins.	4.12	
Diameter	ins.	2.00	
Volume	cc's	212.10	
Unit Weight	#/cu.ft	138.72	
Cross-sect. Area	sq.in	3.14	
Test -- Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.in		
Unit Weight	#/cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	-
Date Fabricated	Jan 19/56
Date Tested	Feb 18/56
Testing Temperature	10 °F
Accelerated Aging:	29 hrs. @140°F
Rate of Strain	0.08 in/min
Proving Ring	10,000 #Cap

2201

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0017	0.01	.0083	.20	238	76
.0074	0.02	.013	.31	1035	330
.0125	0.03	.018	.44	1750	558
.0173	0.04	.023	.56	2425	772
.0209	0.05	.029	.70	2925	932
.0244	0.06	.036	.87	3420	1079
.0274	0.07	.043	1.05	3830	1222
.0294	0.08	.051	1.24	4110	1310
.0311	0.09	.059	1.43	4350	1386
.0323	0.10	.068	1.65	4520	1480
.0325	0.11	.078	1.90	4550	1450
.0323	0.12	.088	2.14	4520	1440
.0320	0.13	.098	2.38	4510	1430
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

#

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
	0.00				
	0.01				
	0.02				
	0.03				
	0.04				
	0.05				
	0.06				
	0.07				
	0.08				
	0.09				
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

University of Illinois
Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 54

Project

Code No's. C-222

Technician BPS

Date: Feb 18/56

Specimen	2221	2222
Test — Compression	x	x
Length ins.	4.03	4.15
Diameter ins.	2.00	2.00
Volume cc's	207.5	213.6
Unit Weight #/cu.ft.	141.0	141.1
Cross-sect. Area sq.ins.	3.14	3.14
Test — Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.ins.		
Unit Weight #/cu.ft.		
Volume cc's		

% Asphalt	8.0
Type Asphalt	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabric.	Jan 20/56
Date Tested	Feb 18/56
Testing Temperature	10 °F
Accelerated Aging	29 days @ 140 °F
Rate of Strain	0.08 in/min
Proving Ring	10,000 # Cap.

#2221

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0025	0.01	.0075	.19	350	112
.0063	0.02	.014	.35	882	281
.0109	0.03	.019	.47	1525	486
.0164	0.04	.024	.60	2295	731
.0220	0.05	.028	.69	3075	979
.0278	0.06	.032	.79	3890	1240
.0307	0.07	.039	.97	4295	1368
.0331	0.08	.047	1.17	4630	1478
.0347	0.09	.056	1.39	4855	1550
.0352	0.10	.065	1.61	4920	1569
.0353	0.11	.075	1.86	4935	1572
.0348	0.12	.085	2.11	4865	1562
.0340	0.13	.096	2.38	4755	1515
.0331	0.14	.107	2.66	4630	1477
.0321	0.15	.118	2.96	4495	1431
.0305	0.16	.129	3.20	4260	1360
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

#2222

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0029	0.01	.0071	.17	406	129
.0079	0.02	.012	.29	1105	352
.0141	0.03	.016	.39	1975	629
.0200	0.04	.020	.48	2800	891
.0265	0.05	.034	.58	3710	1182
.0310	0.06	.029	.70	4340	1382
.0344	0.07	.036	.87	4810	1535
.0366	0.08	.043	1.04	5120	1632
.0369	0.09	.053	1.28	5160	1645
.0360	0.10	.064	1.55	5040	1608
.0345	0.11	.075	1.81	4825	1539
.0325	0.12	.087	2.10	4550	1450
.0305	0.13	.099	2.39	4260	1358
.0283	0.14	.112	2.70	3960	1262
.0263	0.15	.124	2.99	3680	1072
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

University of Alberta

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 55

Project

Code No's. C-224

Technician BPS

Date: Feb 18/56

Specimen	2241	2242
Test — Compression	x	x
Length ins.	4.21	4.24
Diameter ins.	2.00	2.00
Volume cc's	216.7	218.3
Unit Weight #/cu.ft.	140.2	139.7
Cross-sect. Area sq.in.	3.14	3.14
Test — Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.ins.		
Unit Weight #/cu.ft.		
Volume cc's		

% Asphalt	8.0
Type Asphalt	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 22/56
Date Tested	Feb 18/56
Testing Temperature	10
Accelerated Aging:	29 hrs @ 140
Rate of Strain	0.08 in/min
Proving Ring	10,000 #'s

2241

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0018	0.01	.0082	.195	252	80
.0058	0.02	.014	.33	812	259
.0117	0.03	.018	.43	1638	522
.0180	0.04	.022	.52	2520	803
.0232	0.05	.027	.64	3245	1007
.0276	0.06	.032	.76	3860	1230
.0314	0.07	.039	.93	4390	1398
.0344	0.08	.046	1.09	4810	1532
.0358	0.09	.055	1.31	5050	1610
.0363	0.10	.064	1.52	5080	1620
.0358	0.11	.074	1.76	5050	1610
.0334	0.12	.087	2.06	4670	1489
.0320	0.13	.098	2.32	4480	1430
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2242

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0009	0.01	.0091	.21	126	40
.0032	0.02	.017	.40	448	143
.0078	0.03	.022	.52	1082	345
.0138	0.04	.026	.61	1932	616
.0200	0.05	.030	.71	2800	891
.0261	0.06	.034	.80	3650	1162
.0310	0.07	.039	.92	4340	1382
.0345	0.08	.045	1.06	4830	1540
.0368	0.09	.053	1.25	5150	1641
.0378	0.10	.062	1.46	5290	1683
.0380	0.11	.072	1.70	5310	1695
.0375	0.12	.082	1.93	5245	1670
.0362	0.13	.094	2.22	5060	1615
.0345	0.14	.105	2.48	4825	1538
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 56
Project
Code No's. C-226
Technician BPS
Date: Feb 18/56

Specimen	2261	2262
Test — Compression	4.29	4.27
Length Ins.	2.00	2.00
Diameter Ins.	220.8	219.8
Volume cc's	140.7	140.7
Unit Weight #/cu.ft.	3.14	3.14
Cross-sect. Area sq. in.		
Test — Tension		
Width Ins.		
Depth Ins.		
Cross-sect. Area sq. in.		
Unit Weight #/cu.ft.		
Volume cc's		

% Asphalt Content	8.0
Type Asphalt	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 23/56
Date Tested	Feb 18/56
Testing Temperature	10
Accelerated Aging	29 hrs. @ 140
Rate of Strain	0.08 in/min
Proving Ring	10,000 lbs

2261

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0020	0.01	.0080	.19	280	89
.0040	0.02	.016	.37	560	178
.0100	0.03	.020	.47	1400	446
.0180	0.04	.022	.51	2520	802
.0242	0.05	.026	.61	2885	919
.0302	0.06	.030	.70	4250	1354
.0346	0.07	.035	.82	4840	1540
.0381	0.08	.042	.98	5325	1698
.0403	0.09	.050	1.17	5640	1795
.0410	0.10	.059	1.38	5740	1829
.0408	0.11	.069	1.61	5710	1820
.0394	0.12	.081	1.89	5510	1758
.0376	0.13	.092	2.14	5260	1679
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2262

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0046	0.01	.0054	.13	644	205
.0107	0.02	.0099	.23	1498	476
.0158	0.03	.014	.33	2215	705
.0201	0.04	.020	.47	2815	896
.0238	0.05	.026	.61	3330	1062
.0275	0.06	.032	.75	3850	1195
.0300	0.07	.040	.93	4200	1338
.0315	0.08	.048	.112	4405	1405
.0326	0.09	.057	.133	4560	1453
.0333	0.10	.067	.157	4655	1485
.0332	0.11	.077	.180	4645	1479
.0325	0.12	.087	.204	4545	1448
.0313	0.13	.099	.232	4380	1397
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 57

Project

Code No's: C-320

Technician BPS

Date: Feb 18/56

Specimen		3201	3202
Test -- Compression		x	x
Length	ins.	4.12	4.05
Diameter	ins.	2.00	2.00
Volume	cc's	212.1	140.7
Unit Weight	#/cu.ft	213.6	139.5
Cross-sect. Area	sq.in	3.14	3.14
Test -- Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.in		
Unit Weight	#/cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	-
Date Fabricated	Jan 19/56
Date Tested	Feb 18/56
Testing Temperature	10 °F
Accelerated Aging:	70 hrs. @ 140°F
Rate of Strain	0.08 in/min
Proving Ring	10,000 #Cap.

# 3201						# 3202					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0035	0.01	.0065	.16	490	156	.0038	0.01	.0062	.15	531	169
.0098	0.02	.010	.24	1372	437	.0107	0.02	.0093	.23	1498	477
.0159	0.03	.014	.34	2225	698	.0170	0.03	.013	.32	2380	758
.0216	0.04	.018	.44	3025	964	.0226	0.04	.017	.42	3165	1008
.0270	0.05	.023	.56	3780	1198	.0275	0.05	.022	.54	3850	1227
.0300	0.06	.030	.73	4200	1338	.0302	0.06	.030	.74	4225	1348
.0323	0.07	.038	.92	4520	1440	.0319	0.07	.038	.94	4460	1422
.0337	0.08	.046	1.11	4710	1504	.0328	0.08	.047	1.06	4590	1460
.0339	0.09	.056	1.36	4745	1510	.0331	0.09	.057	1.41	4635	1475
.0337	0.10	.066	1.60	4710	1504	.0328	0.10	.067	1.65	4590	1460
.0332	0.11	.077	1.87	4645	1479	.0322	0.11	.078	1.93	4505	1435
.0322	0.12	.088	2.14	4505	1435	.0313	0.12	.089	2.20	4380	1396
.0314	0.13	.099	2.40	4395	1400	.0298	0.13	.010	2.47	4160	1328
.0305	0.14	.109	2.64	4265	1360	.0281	0.14	.012	2.95	3935	1253
	0.15						0.15				
	0.16						0.16				
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 58

Project

Code No's. C-322

Technician BPS

Date: Feb 18/56

Specimen	3221	3222
Test -- Compression	x	x
Length ins.	4.16	4.12
Diameter ins.	2.00	2.00
Volume cc's	214.2	212.1
Unit Weight #/cu.ft	141.6	141.3
Cross-sect. Area sq.in	3.14	3.14
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.in		
Unit Weight #/Cu ft		
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 COmm
Date Fabricated	Jan 21/56
Date Tested	Feb 18/56
Testing Temperature	10 °F
Accelerated Aging:	70 hrs. @ 140 F
Rate of Strain	0.08 in/min
Proving Ring	10,000 # Cap.

3221

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0040	0.01	.0060	.14	560	179
.0103	0.02	.0097	.23	1442	359
.0171	0.03	.013	.31	2395	713
.0225	0.04	.017	.41	3142	1000
.0267	0.05	.023	.55	3735	1190
.0298	0.06	.030	.72	4160	1328
.0315	0.07	.039	.94	4410	1409
.0324	0.08	.048	1.16	4530	1444
.0324	0.09	.058	1.40	4530	1444
.0322	0.10	.068	1.64	4505	1436
.0319	0.11	.078	1.89	4460	1420
.0313	0.12	.089	2.14	4375	1393
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3222

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0036	0.01	.0064	.16	504	161
.0093	0.02	.011	.27	1303	415
.0153	0.03	.015	.36	2143	683
.0214	0.04	.019	.46	2995	954
.0265	0.05	.023	.56	3710	1182
.0314	0.06	.029	.70	4395	1399
.0342	0.07	.036	.87	4790	1516
.0358	0.08	.044	1.07	5005	1595
.0367	0.09	.054	1.31	5060	1612
.0360	0.10	.064	1.55	5040	1606
.0352	0.11	.075	1.82	4920	1569
.0341	0.12	.086	2.09	4765	1520
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 59

Project

Code No's. C-324

Technician BPS

Date: Feb 18/56

Specimen	3241	3242
Test -- Compression	x	x
Length ins.	4.11	4.17
Diameter ins.	2.00	2.00
Volume cc's	211.6	214.6
Unit Weight #/cu.ft	140.5	141.3
Cross-sect. Area sq.in	3.14	3.14
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.in		
Unit Weight #/cu.ft		
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 22/56
Date Tested	Feb 18/56
Testing Temperature	10 °F
Accelerated Aging:	70 hrs. @ 140°F
Rate or Strain	0.08 in/min.
Proving Ring	10,000 #Cap.

3241

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0039	0.01	.0061	.15	545	174
.0103	0.02	.0097	.24	1442	459
.0158	0.03	.014	.34	2210	704
.0205	0.04	.019	.46	2855	909
.0245	0.05	.026	.63	3430	1092
.0275	0.06	.032	.78	3850	1228
.0298	0.07	.040	.97	4165	1328
.0313	0.08	.049	1.19	4380	1395
.0323	0.09	.058	1.41	4515	1439
.0325	0.10	.067	1.63	4548	1449
.0320	0.11	.078	1.90	4475	1427
.0310	0.12	.089	2.17	4340	1382
.0295	0.13	.101	2.46	4125	1314
.0278	0.14	.112	2.73	3890	1240
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3242

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0024	0.01	.0076	.19	336	107
.0073	0.02	.013	.32	1023	326
.0132	0.03	.017	.41	1848	588
.0196	0.04	.020	.48	2745	874
.0261	0.05	.024	.58	3650	1163
.0309	0.06	.029	.71	4325	1379
.0342	0.07	.036	.88	4740	1510
.0367	0.08	.043	1.05	5140	1638
.0378	0.09	.052	1.27	5290	1683
.0378	0.10	.062	1.51	5290	1683
.0374	0.11	.073	1.78	5235	1668
.0362	0.12	.084	2.05	5060	1613
.0345	0.13	.095	2.31	4830	1539
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 60

Project

Code No's. C-326

Technician BPS

Date: Feb 18/56

Specimen		3261	3262
Test -- Compression		x	x
Length	ins.	4.18	4.26
Diameter	ins.	2.00	2.00
Volume	cc's	215.2	219.3
Unit Weight	#/cu.ft	139.6	139.2
Cross-sect. Area	sq. in	3.14	3.14
Test -- Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq. in		
Unit Weight	#/Cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 23/56
Date Tested	Feb 18/56
Testing Temperature	10 °F
Accelerated Aging:	70 hrs. @140°F
Rate of Strain	0.08 in/min.
Proving Ring	10,000 #Cap.

3261

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0054	0.01	.0046	.11	756	241
.0115	0.02	.009	.22	1610	513
.0185	0.03	.012	.29	2590	825
.0240	0.04	.016	.38	3380	1078
.0286	0.05	.023	.55	4000	1274
.0324	0.06	.028	.67	4535	1443
.0345	0.07	.036	.86	4825	1538
.0363	0.08	.044	1.05	5080	1618
.0367	0.09	.053	1.27	5140	1637
.0366	0.10	.063	1.51	5120	1632
.0358	0.11	.074	1.77	5005	1597
.0347	0.12	.085	2.04	4955	1579
.0334	0.13	.097	2.32	4670	1488
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3262

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0037	0.01	.0063	.15	518	165
.0087	0.02	.011	.26	1218	388
.0140	0.03	.016	.37	1960	624
.0202	0.04	.020	.47	2830	902
.0253	0.05	.025	.59	3540	1128
.0295	0.06	.031	.73	4130	1318
.0322	0.07	.038	.89	4505	1437
.0337	0.08	.046	1.08	4710	1503
.0347	0.09	.055	1.29	4855	1549
.0347	0.10	.065	1.53	4855	1549
.0340	0.11	.076	1.78	4755	1517
.0325	0.12	.087	2.04	4550	1450
.0313	0.13	.099	2.32	4380	1395
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 61

Project	
Code No's.	C-130
Technician	Feb 18/56
Date:	BPS

Specimen		1301	1302
Test -- Compression		x	x
Length	ins.	4.15	4.15
Diameter	ins.	2.00	2.00
Volume	cc's	213.6	213.6
Unit Weight	#/cu.ft	139.3	139.3
Cross-sect. Area	sq.in	3.14	3.14
Test -- Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.in		
Unit Weight	#/cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	θ
Type Additive	–
Date Fabricated	Jan 18/56
Date Tested	Feb 18/56
Testing Temperature	36 °F
Accelerated Aging:	– hrs. @ – °F
Rate of Strain	0.08 in/min.
Proving Ring	600/1301 10,000/1307 #Cap.

#1301 600# Ring

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0069	0.01	.0031	.07	95	30.2
.0142	0.02	.0058	.14	195	62
.0208	0.03	.0092	.22	286	91
.0265	0.04	.013	.31	365	116
.0322	0.05	.018	.43	443	141
.0378	0.06	.022	.53	520	166
.0431	0.07	.027	.65	593	189
.0482	0.08	.032	.77	664	211
.0535	0.09	.036	.87	736	235
.0582	0.10	.042	1.03	800	265
.0625	0.11	.047	1.07	860	274
.0672	0.12	.053	1.28	925	295
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

#1302 10,000# Ring

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0019	0.01	.0071	.17	266	85
.0032	0.02	.017	.41	448	143
.0041	0.03	.026	.62	574	183
.0050	0.04	.035	.84	700	223
.0059	0.05	.044	1.06	825	263
.0062	0.06	.054	1.30	867	289
.0068	0.07	.063	1.52	952	303
.0070	0.08	.073	1.76	979	312
.0071	0.09	.083	2.00	993	318
.0071	0.10	.093	2.24	993	318
.0071	0.11	.103	2.48	993	318
.0070	0.12	.113	2.72	979	312
.0068	0.13	.123	2.97	952	303
.0065	0.14	.133	3.20	909	289
.0062	0.15	.144	3.47	857	273
.0059	0.16	.154	3.72	825	263
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 62

Project

Code No's. C-132

Technician BPS

Date: Feb 18/56

Specimen		1321	1322
Test -- Compression		4.13	3.95
Length	ins.	2.00	2.00
Diameter	ins.	212.6	203.4
Volume	cc's	138.4	137.7
Unit Weight	#/cu.ft	3.14	3.14
Cross-sect. Area	sq.in		
Test -- Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.in		
Unit Weight	#/Cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 20/56
Date Tested	Feb 18/56
Testing Temperature	36 °F
Accelerated Aging:	- hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	10,000 #Cap.

# 1321						# 1322					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0015	0.01	.0085	.20	280	89	.0021	0.01	.0079	.20	294	94
.0029	0.02	.017	.41	406	129	.0037	0.02	.016	.40	518	165
.0041	0.03	.026	.63	573	183	.0050	0.03	.025	.63	700	223
.0051	0.04	.035	.85	713	237	.0059	0.04	.034	.85	826	263
.0060	0.05	.044	1.06	849	270	.0067	0.05	.043	1.08	936	298
.0067	0.06	.053	1.27	936	296	.0073	0.06	.053	1.33	1021	325
.0073	0.07	.063	1.53	1022	326	.0079	0.07	.062	1.56	1150	366
.0078	0.08	.072	1.74	1092	348	.0083	0.08	.072	1.81	1162	370
.0080	0.09	.082	1.98	1119	354	.0084	0.09	.082	2.07	1175	374
.0081	0.10	.092	2.23	1133	361	.0085	0.10	.092	2.32	1190	379
.0080	0.11	.102	2.48	1119	354	.0084	0.11	.102	2.57	1175	374
.0078	0.12	.112	2.72	1092	348	.0082	0.12	.112	2.85	1148	365
.0075	0.13	.123	2.98	1049	334	.0080	0.13	.122	3.08	1119	356
.0072	0.14	.133	3.22	1007	321	.0078	0.14	.132	3.34	1092	348
.0069	0.15	.143	3.46	965	307	.0074	0.15	.143	3.63	1035	329
	0.16						0.16				
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 63

Project	
Code No's.	C-134
Technician	BPS
Date:	Feb 18/56

Specimen		1341	1342
Test — Compression		x	x
Length	ins	4.13	4.10
Diameter	ins.	2.00	2.00
Volume	cc's	212.6	211.1
Unit Weight	#/cu.ft	140.5	139.2
Cross-sect. Area	sq.in	3.14	3.14
Test — Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.in		
Unit Weight	#/cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 22/56
Date Tested	Feb 18/56
Testing Temperature	36 °F
Accelerated Aging:	- hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	10,000 #Cap.

#1341

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0034	0.01	.0066	.16	476	152
.0052	0.02	.015	.36	727	232
.0066	0.03	.023	.55	923	294
.0078	0.04	.032	.81	1092	348
.0090	0.05	.041	1.05	1258	400
.0097	0.06	.050	1.26	1358	432
.0100	0.07	.060	1.52	1400	446
.0103	0.08	.070	1.77	1442	459
.0102	0.09	.080	2.02	1428	454
.0100	0.10	.090	2.28	1400	446
.0096	0.11	.100	2.53	1342	428
.0091	0.12	.111	2.81	1273	406
.0085	0.13	.122	3.09	1190	379
.0081	0.14	.132	3.26	1132	361
.0078	0.15	.142	3.42	1092	348
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

#1342

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0028	0.01	.0072	.17	392	126
.0046	0.02	.015	.36	644	205
.0058	0.03	.024	.58	812	259
.0070	0.04	.033	.80	979	311
.0082	0.05	.042	1.02	1148	367
.0091	0.06	,051	1.24	1272	405
.0098	0.07	.060	1.46	1372	438
.0102	0.08	.070	1.71	1427	454
.0103	0.09	.080	1.95	1441	459
.0103	0.10	.090	2.20	1441	459
.0102	0.11	.100	2.44	1428	454
.0101	0.12	.110	2.68	1413	450
.0097	0.13	.120	2.93	1358	432
.0092	0.14	.131	3.20	1288	409
.0086	0.15	.149	3.63	1207	384
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 64

Project:

Code No's. C-136

Technician BPS

Date: Feb 19/56

Specimen		1361	1362
Test — Compression		x	x
Length	ins.	4.22	4.04
Diameter	ins.	2.00	2.00
Volume	cc's	217.3	208.0
Unit Weight	#/cu.ft	138.2	136.8
Cross-sect. Area	sq.in	3.14	3.14
Test — Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.in		
Unit Weight	#/cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 23/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	- hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	10,000 #Cap.

1361

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0020	0.01	.008	.19	280	89
.0032	0.02	.017	.40	448	143
.0042	0.03	.026	.61	588	187
.0052	0.04	.035	.83	727	231
.0062	0.05	.044	1.05	867	276
.0068	0.06	.053	1.26	952	303
.0070	0.07	.063	1.49	979	312
.0071	0.08	.073	1.74	993	316
.0068	0.09	.083	1.97	952	303
.0065	0.10	.093	2.21	909	289
.0062	0.11	.104	2.47	867	276
.0058	0.12	.114	2.71	812	259
.0053	0.13	.125	2.97	741	236
.0050	0.14	.135	3.20	700	211
.0048	0.15	.145	3.44	671	214
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1362

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0021	0.01	.0079	.19	294	94
.0035	0.02	.017	.42	489	156
.0045	0.03	.025	.62	629	200
.0055	0.04	.034	.84	769	245
.0065	0.05	.044	1.09	909	289
.0072	0.06	.053	1.32	1008	321
.0080	0.07	.062	1.54	1119	356
.0083	0.08	.072	1.78	1162	370
.0084	0.09	.082	2.03	1176	374
.0083	0.10	.092	2.28	1162	370
.0082	0.11	.102	2.50	1147	366
.0078	0.12	.112	2.79	1092	348
.0073	0.13	.123	3.04	1023	326
.0069	0.14	.133	3.29	979	312
.0065	0.15	.143	3.54	909	289
.0060	0.16	.154	3.82	840	268
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 65

Project

Code No's: C-230

Technician BPS

Date: Feb 19/56

Specimen		2301	2302
Test — Compression		x	x
Length	ins.	4.20	4.15
Diameter	ins.	2.00	2.00
Volume	cc's	216.2	213.6
Unit Weight	#/cu.ft	138.7	140.7
Cross-sect. Area	sq. in	3.14	3.14
Test — Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq. in		
Unit Weight	#/cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	-
Date Fabricated	Jan 19/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	29 hrs. @ 140°F
Rate of Strain	0.08 in/min
Proving Ring	10,000 #Cap

2301

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0021	0.01	.0079	.18	294	94
.0040	0.02	.016	.38	559	178
.0055	0.03	.024	.57	769	245
.0068	0.04	.037	.88	952	313
.0076	0.05	.042	1.00	1062	338
.0085	0.06	.051	1.23	1189	378
.0090	0.07	.061	1.45	1260	401
.0095	0.08	.070	1.67	1330	423
.0098	0.09	.080	1.90	1372	437
.0099	0.10	.090	2.12	1386	441
.0099	0.11	.100	2.28	1386	441
.0098	0.12	.110	2.62	1572	437
.0094	0.13	.121	2.88	1316	419
.0091	0.14	.131	3.11	1273	405
.0088	0.15	.141	3.35	1232	392
.0085	0.16	.152	3.61	1189	378
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2302

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0021	0.01	.0079	.19	294	94
.0042	0.02	.016	.38	587	187
.0057	0.03	.024	.57	797	254
.0071	0.04	.037	.89	993	316
.0081	0.05	.042	1.01	1133	361
.0088	0.06	.051	1.23	1232	393
.0096	0.07	.060	1.45	1343	428
.0101	0.08	.070	1.69	1413	450
.0102	0.09	.080	1.93	1428	454
.0103	0.10	.090	2.17	1442	459
.0103	0.11	.100	2.41	1442	459
.0102	0.12	.110	2.52	1428	454
.0101	0.13	.120	2.89	1413	450
.0099	0.14	.130	3.12	1385	441
.0097	0.15	.140	3.37	1358	432
.0092	0.16	.151	3.64	1288	409
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

DEPT. OF CIVIL ENGINEERING

ASPHALT ADMIXTURE INVESTIGATION

Project:
Case No.: C-232
Technician: BPS
Date: Feb 19/56

Specimen	2321	2322
Test -- Compression	x	x
Length ins.	4.10	4.16
Diameter ins.	2.00	2.00
Volume cc's	211.1	214.7
Unit Weight #/cu.ft	137.2	140.2
Cross-sect. Area sq.in	3.14	3.14
Test -- Tension		
Width ins.		
Depth ins.		
Cross-sect. Area sq.in		
Unit Weight #/cu.ft		
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 20/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	29 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	10,000 #Cap.

2321

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0016	0.01	.0084	.20	224	71
.0038	0.02	.0172	.42	532	169
.0053	0.03	.025	.61	741	236
.0067	0.04	.033	.80	937	299
.0076	0.05	.042	1.03	1063	339
.0083	0.06	.059	1.27	1162	370
.0089	0.07	.061	1.49	1245	396
.0094	0.08	.071	1.74	1315	418
.0098	0.09	.080	1.96	1372	437
.0100	0.10	.090	2.20	1400	446
.0100	0.11	.100	2.45	1400	446
.0099	0.12	.110	2.69	1385	441
.0097	0.13	.120	2.94	1358	432
.0092	0.14	.131	3.20	1288	410
.0089	0.15	.141	3.44	1245	396
.0084	0.16	.152	3.70	1175	374

2322

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0022	0.01	.0078	.19	308	98
.0047	0.02	.015	.36	675	215
.0065	0.03	.024	.57	909	289
.0077	0.04	.032	.77	1078	343
.0088	0.05	.041	.98	1232	392
.0096	0.06	.050	1.21	1343	428
.0102	0.07	.060	1.44	1428	454
.0107	0.08	.069	1.66	1498	476
.0108	0.09	.079	1.90	1512	483
.0108	0.10	.089	2.07	1512	483
.0108	0.11	.099	2.38	1512	483
.0107	0.12	.109	2.62	1498	476
.0105	0.13	.119	2.86	1469	463
.0103	0.14	.130	3.16	1442	459
.0099	0.15	.140	3.36	1385	440
.0093	0.16	.151	3.61	1310	416

Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Project:	
Case No.:	C-234
Technician	BPS
Date:	Feb 19/56

Specimen		2341	2342
Test – Compression		x	x
Length	ins.	4.15	4.22
Diameter	ins.	2.00	2.00
Volume	cc's	213.6	217.3
Unit Weight	#/cu.ft	141.0	141.7
Cross-sect. Area	sq.in	3.14	3.14
Test – Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.in		
Unit Weight	#/cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 22/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	29 hrs. @ 140 °F
Rate of Strain	0.08 in/min.
Proving Ring	10,000 #Cap.

2341

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0020	0.01	.0080	.19	280	89
.0041	0.02	.016	.38	574	183
.0058	0.03	.024	.57	812	259
.0071	0.04	.033	.79	993	316
.0080	0.05	.042	1.01	1120	356
.0089	0.06	.051	1.23	1245	396
.0093	0.07	.061	1.47	1302	414
.0100	0.08	.070	1.69	1400	446
.0102	0.09	.080	1.93	1428	454
.0103	0.10	.090	2.17	1442	459
.0102	0.11	.100	2.42	1428	454
.0099	0.12	.110	2.68	1303	414
.0093	0.13	.121	2.92	1246	396
.0089	0.14	.131	3.16	1186	388
.0084	0.15	.142	3.41	1162	370
.0080	0.16	.152	3.66	1120	356
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2342

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0029	0.01	.0071	.16	406	129
.0051	0.02	.015	.35	714	229
.0069	0.03	.023	.54	965	307
.0080	0.04	.032	.76	1120	356
.0091	0.05	.041	.97	1274	406
.0101	0.06	.050	1.09	1414	450
.0108	0.07	.059	1.40	1512	481
.0111	0.08	.067	1.59	1564	498
.0113	0.09	.079	1.87	1582	504
.0113	0.10	.089	2.11	1582	504
.0111	0.11	.099	2.35	1564	498
.0109	0.12	.109	2.59	1526	486
.0105	0.13	.120	2.85	1470	468
.0101	0.14	.130	3.09	1414	450
.0098	0.15	.140	3.32	1372	437
.0093	0.16	.150	3.56	1302	414
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 68

Project:

Case No's. C-236

Technician BPS

Date: Feb 19/56

Specimen		2361	2362
Test -- Compression		x	x
Length	ins.	4.22	4.11
Diameter	ins.	2.00	2.00
Volume	cc's	217.3	211.6
Unit Weight	#/cu.ft	141.9	141.2
Cross-sect. Area	sq.in	3.14	3.14
Test -- Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.in		
Unit Weight	#/cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 23/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	29 hrs. @ 140 °F
Rate of Strain	0.08 in/min.
Proving Ring	10,000 #Cap.

2361

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0039	0.01	.0061	.14	546	174
.0068	0.02	.013	.30	952	303
.0088	0.03	.022	.52	1232	392
.0102	0.04	.030	.71	1428	454
.0113	0.05	.039	.92	1582	500
.0126	0.06	.048	1.04	1764	562
.0130	0.07	.057	1.35	1820	579
.0133	0.08	.067	1.59	1862	593
.0134	0.09	.077	1.83	1876	596
.0133	0.10	.087	2.03	1862	593
.0131	0.11	.097	2.30	1834	584
.0128	0.12	.107	2.54	1792	571
.0121	0.13	.118	2.80	1694	539
.0116	0.14	.129	3.06	1624	517
.0111	0.15	.139	3.29	1554	494
.0105	0.16	.150	3.56	1470	
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2362

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0025	0.01	.0075	.18	350	111
.0049	0.02	.015	.36	696	222
.0065	0.03	.023	.56	910	290
.0079	0.04	.032	.78	1106	320
.0090	0.05	.041	.99	1260	401
.0099	0.06	.050	1.21	1386	441
.0103	0.07	.060	1.46	1442	459
.0105	0.08	.070	1.70	1470	463
.0105	0.09	.080	1.94	1470	463
.0103	0.10	.090	2.19	1442	459
.0099	0.11	.100	2.43	1385	441
.0094	0.12	.111	2.70	1315	418
.0089	0.13	.121	2.94	1245	396
.0083	0.14	.132	3.20	1162	370
.0079	0.15	.142	3.45	1106	352
.0072	0.16	.153	3.72	1008	321
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 69

Project

Code No's. C-330

Technician BPS

Date: Feb 19/56

Specimen		3201	3202
Test -- Compression		x	x
Length	ins.	4.12	4.15
Diameter	ins.	2.00	2.00
Volume	cc's	212.1	206.4
Unit Weight	#/cu.ft	140.6	140.3
Cross-sect. Area	sq.in	3.14	3.14
Test -- Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.in		
Unit Weight	#/cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	–
Date Fabricated	Jan 19/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	70 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	10,000 #Cap.

# 3201						# 3202					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0028	0.01	.0072	.17	392	125	.0021	0.01	.0079	.19	294	93
.0051	0.02	.015	.36	714	227	.0045	0.02	.015	.36	630	201
.0064	0.03	.024	.58	896	285	.0061	0.03	.024	.57	854	272
.0076	0.04	.032	.77	1064	339	.0073	0.04	.033	.79	1022	315
.0086	0.05	.041	.91	1204	383	.0086	0.05	.041	.99	1204	383
.0092	0.06	.051	1.23	1288	409	.0094	0.06	.051	1.23	1316	418
.0099	0.07	.060	1.45	1386	434	.0101	0.07	.060	1.44	1414	450
.0102	0.08	.070	1.69	1428	454	.0105	0.08	.070	1.69	1470	468
.0103	0.09	.080	1.94	1441	459	.0108	0.09	.080	1.93	1512	482
.0103	0.10	.090	2.18	1441	459	.0110	0.10	.089	2.14	1540	490
.0103	0.11	.100	2.42	1441	459	.0111	0.11	.099	2.38	1554	495
.0102	0.12	.110	2.68	1428	454	.0110	0.12	.109	2.62	1540	490
.0099	0.13	.120	2.90	1386	434	.0108	0.13	.119	2.89	1512	482
.0096	0.14	.130	3.16	1344	428	.0106	0.14	.129	3.11	1484	473
.0092	0.15	.141	3.42	1288	409	.0103	0.15	.140	3.38	1442	459
.0088	0.16	.151	3.66	1232	392	.0100	0.16	.150	3.62	1400	445
	0.17						0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

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Dept. of Civil Engineering

ASPHALT ADMIXTURE INVESTIGATION

Sheet 70

Project

Code No's. C-332

Technician BPS

Date: Feb 19/56

Specimen		3321	3322
Test — Compression		x	x
Length	Ins.	4.20	4.17
Diameter	Ins.	2.00	2.00
Volume	cc's	216.2	214.7
Unit Weight	#/cu.ft	140.3	141.2
Cross-sect. Area	sq.in	3.14	3.14
Test — Tension			
Width	Ins.		
Depth	Ins.		
Cross-sect. Area	sq.in		
Unit Weight	#/Cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 21/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	70 hrs. @ 140°F
Rate of Strain	in/min.
Proving Ring	10,000 #Cap.

3321

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0031	0.01	.0069	.165	434	138
.0059	0.02	.014	.33	826	263
.0078	0.03	.022	.52	1092	348
.0090	0.04	.031	.74	1260	400
.0103	0.05	.040	.95	1442	459
.0111	0.06	.049	1.17	1554	494
.0118	0.07	.058	1.38	1652	522
.0122	0.08	.068	1.62	1708	543
.0125	0.09	.077	1.83	1750	557
.0126	0.10	.087	2.07	1764	561
.0126	0.11	.097	2.31	1764	561
.0124	0.12	.108	2.58	1736	552
.0121	0.13	.118	2.81	1694	539
.0119	0.14	.128	3.05	1666	530
.0112	0.15	.139	3.31	1568	498
.0110	0.16	.149	3.55	1540	490
.0108	0.17	.159	3.79	1512	481
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3322

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0037	0.01	.0063	.151	518	165
.0062	0.02	.014	.34	868	276
.0081	0.03	.022	.53	1164	371
.0096	0.04	.030	.72	1344	428
.0108	0.05	.039	.93	1512	482
.0117	0.06	.048	1.15	1628	518
.0122	0.07	.058	1.39	1708	543
.0129	0.08	.067	1.61	1806	574
.0132	0.09	.077	1.85	1848	588
.0133	0.10	.087	2.09	1862	593
.0134	0.11	.097	2.33	1876	597
.0133	0.12	.103	2.57	1862	593
.0131	0.13	.117	2.81	1834	584
.0129	0.14	.127	3.05	1806	574
.0125	0.15	.138	3.31	1750	556
.0120	0.16	.148	3.55	1680	534
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 71

Project

Code No's. C-334

Technician BPS

Date: Feb 19/56

Specimen		3341	3342
Test -- Compression		x	x
Length	ins.	4.26	4.23
Diameter	ins.	2.00	2.00
Volume	cc's	219.3	217.8
Unit Weight	#/cu.ft	141.0	141.0
Cross-sect. Area	sq.in	3.14	3.14
Test -- Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.in		
Unit Weight	#/Cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 22/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	70 hrs. @140 °F
Rate of Strain	0.08 in/min.
Proving Ring	10,000 #Cap.

3341

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0032	0.01	.0068	.16	448	141
.0063	0.02	.014	.33	882	281
.0086	0.03	.023	.54	1204	383
.0100	0.04	.030	.71	1400	446
.0109	0.05	.039	.92	1526	486
.0118	0.06	.048	1.13	1652	526
.0121	0.07	.058	1.36	1694	539
.0126	0.08	.067	1.58	1764	561
.0138	0.09	.077	1.81	1792	571
.0129	0.10	.087	2.05	1806	574
.0128	0.11	.097	2.28	1792	570
.0124	0.12	.108	2.54	1736	552
.0120	0.13	.118	2.78	1680	534
.0117	0.14	.128	3.01	1628	517
.0113	0.15	.139	3.27	1582	504
.0109	0.16	.149	3.50	1526	486
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3341

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0036	0.01	.0064	.15	504	160
.0058	0.02	.014	.33	812	259
.0076	0.03	.023	.54	1064	339
.0088	0.04	.031	.73	1232	392
.0097	0.05	.040	.94	1358	442
.0104	0.06	.050	1.18	1456	463
.0109	0.07	.059	1.39	1526	486
.0110	0.08	.069	1.63	1540	490
.0111	0.09	.079	1.87	1554	495
.0109	0.10	.089	2.11	1526	485
.0105	0.11	.100	2.36	1470	468
.0102	0.12	.110	2.60	1428	454
.0097	0.13	.120	2.84	1358	432
.0092	0.14	.131	3.10	1288	410
.0087	0.15	.141	3.33	1218	387
.0082	0.16	.152	3.59	1148	365
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 72

Project	
Code No's.	C-336
Technician	BPS
Date:	Feb 19/56

Specimen		3361	3362
Test -- Compression		x	x
Length	ins.	4.21	4.13
Diameter	ins.	2.00	2.00
Volume	cc's	216.7	212.6
Unit Weight	#/cu.ft	140.3	133.5
Cross-sect. Area	sq.in	3.14	3.14
Test -- Tension			
Width	ins.		
Depth	ins.		
Cross-sect. Area	sq.in		
Unit Weight	#/Cu.ft		
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 23/56
Date Tested	Feb 19/56
Testing Temperature	36°F
Accelerated Aging:	70 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	10,000 #Cap.

3361

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0039	0.01	.0061	.14	546	173
.0071	0.02	.013	.31	994	316
.0094	0.03	.021	.50	1316	418
.0109	0.04	.029	.69	1526	486
.0120	0.05	.038	.90	1680	534
.0129	0.06	.047	1.12	1806	574
.0135	0.07	.056	1.33	1890	601
.0138	0.08	.066	1.58	1932	615
.0138	0.09	.076	1.81	1932	615
.0134	0.10	.087	2.07	1878	597
.0129	0.11	.097	2.30	1806	574
.0122	0.12	.108	2.57	1708	543
.0119	0.13	.118	2.80	1666	530
.0113	0.14	.129	3.06	1582	504
.0108	0.15	.139	3.30	1512	482
.0102	0.16	.180	3.56	1428	454
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3362

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0038	0.01	.0062	.15	582	185
.0072	0.02	.013	.31	1008	320
.0096	0.03	.020	.48	1344	428
.0109	0.04	.029	.70	1526	486
.0120	0.05	.038	.92	1680	534
.0129	0.06	.047	1.14	1806	574
.0134	0.07	.057	1.38	1876	596
.0137	0.08	.066	1.60	1918	610
.0139	0.09	.076	1.84	1918	610
.0138	0.10	.086	2.09	1904	606
.0135	0.11	.096	2.33	1890	601
.0131	0.12	.107	2.60	1834	584
.0128	0.13	.117	2.84	1792	570
.0122	0.14	.128	3.10	1708	544
.0119	0.15	.138	3.36	1666	530
.0110	0.16	.149	3.61	1540	490
.0105	0.17	.160	3.88	1470	468
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 73

Project	
Code No's.	T-130
Technician	BPS
Date:	Feb 19/56

Specimen		1301	1302
Test -- Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.in		
Test -- Tension		x	
Width	ins.	1.00	
Depth	ins.	1.02	
Cross-sect. Area	sq.in	1.02	
Unit Weight	#/cu.ft	142.1	
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	-
Date Fabricated	Jan 25/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

1301

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0003	0.01	.0097	.24	4.1	4.0
.0008	0.02	.019	.475	11.0	10.8
.0013	0.03	.029	.725	17.8	17.4
.0018	0.04	.038	.95	24.7	24.2
.0022	0.05	.048	1.20	30.2	29.6
.0028	0.06	.057	1.42	38.4	37.6
.0032	0.07	.067	1.68	43.9	43.0
.0036	0.08	.076	1.90	49.4	48.4
.0038	0.09	.086	2.15	52.1	51.1
.0037	0.10	.096	2.40	50.8	49.8
.0022	0.11	.108	2.70	30.2	29.6
.0007	0.12	.119	2.98	9.6	9.4
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

Missing

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
	0.00				
	0.01				
	0.02				
	0.03				
	0.04				
	0.05				
	0.06				
	0.07				
	0.08				
	0.09				
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 74

Project

Code No's. T-132

Technician BPS

Date: Feb 19/56

Specimen		1321	1322
Test — Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.in		
Test — Tension		x	x
Width	ins.	1.00	1.06
Depth	ins.	1.02	0.97
Cross-sect. Area	sq.in	1.02	1.03
Unit Weight	#/Cu.ft	141.7	139.5
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 27/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

#1321						#1322					
Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi	Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00					.0000	0.00				
.0003	0.01	.0097	.24	4.1	4.0	.0004	0.01	.0096	.24	5.5	5.3
.0009	0.02	.019	.475	12.35	12.1	.0008	0.02	.019	.475	11.0	10.7
.0019	0.03	.028	.70	26.1	25.6	.0012	0.03	.029	.725	16.5	16.0
.0029	0.04	.037	.925	39.8	39.0	.0016	0.04	.038	.95	22.0	21.4
.0039	0.05	.046	1.15	53.5	52.4	.0022	0.05	.048	1.20	30.2	29.3
.0054	0.06	.055	1.375	74.1	72.6	.0028	0.06	.057	1.43	38.4	37.2
.0068	0.07	.063	1.575	93.3	91.4	.0032	0.07	.067	1.67	43.9	42.6
.0079	0.08	.072	1.80	108.4	106.2	.0038	0.08	.076	1.90	52.1	50.6
.0088	0.09	.081	2.02	120.8	118.2	.0040	0.09	.086	2.13	54.9	53.3
.0095	0.10	.091	2.27	130.3	127.7	.0040	0.10	.096	2.40	54.9	53.3
.0101	0.11	.100	2.50	138.5	135.8	.0040	0.11	.106	2.65	54.9	53.3
.0102	0.12	.110	2.75	139.9	136.9	.0038	0.12	.116	2.93	52.1	50.6
.0100	0.13	.120	3.00	137.2	134.5	.0032	0.13	.127	3.18	43.9	42.6
.0096	0.14	.130	3.25	131.8	129.0	.0025	0.14	.137	3.42	34.3	33.3
.0089	0.15	.141	3.52	122.2	119.9	.0018	0.15	.148	3.70	24.7	24.0
.0078	0.16	.152	3.80	106.9	104.5	.0011	0.16	.159	3.97	15.1	14.7
.0061	0.17	.164	4.10	83.6	82.9		0.17				
	0.18						0.18				
	0.19						0.19				
	0.20						0.20				
	0.21						0.21				
	0.22						0.22				
	0.23						0.23				
	0.24						0.24				
	0.25						0.25				
	0.26						0.26				

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ASPHALT ADMIXTURE INVESTIGATION

	Sheet 75
Project	
Code No's.	T-134
Technician	BPS
Date:	Feb 19/56

Specimen	1341	1342
Test -- Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test -- Tension	x	x
Width ins.	1.00	1.00
Depth ins.	0.98	1.00
Cross-sect. Area sq.in	0.98	1.00
Unit Weight #/Cu.ft	142.0	140.3
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Huskey Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 28/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

1341

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0011	0.01	.0089	.22	15.1	15.4
.0017	0.02	.018	.45	23.4	23.9
.0024	0.03	.028	.70	33.0	33.7
.0032	0.04	.037	.93	43.9	44.8
.0042	0.05	.046	1.15	57.6	58.8
.0056	0.06	.054	1.35	76.9	78.5
.0068	0.07	.063	1.58	93.2	95.1
.0074	0.08	.073	1.83	101.5	103.5
.0077	0.09	.082	2.05	105.7	107.9
.0072	0.10	.093	2.33	98.6	99.6
.0040	0.11	.106	2.65	54.9	56.0
.0018	0.12	.118	2.95	24.7	25.2
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1342

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0009	0.01	.0091	.23	12.4	12.4
.0018	0.02	.018	.45	24.7	24.7
.0029	0.03	.027	.68	39.8	39.8
.0041	0.04	.036	.90	56.2	56.2
.0051	0.05	.045	1.12	70.0	70.0
.0061	0.06	.054	1.35	83.6	83.6
.0070	0.07	.063	1.58	96.0	96.0
.0073	0.08	.073	1.83	100.1	100.1
.0073	0.09	.083	2.07	100.1	100.1
.0072	0.10	.093	2.33	98.7	98.7
.0068	0.11	.103	2.58	93.2	93.2
.0052	0.12	.115	2.88	71.3	71.3
.0031	0.13	.127	3.18	42.5	42.5
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 76

Project

Code No's. T-136

Technician BPS

Date: Feb 19/56

Specimen	1361	1362
Test -- Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test -- Tension	x	x
Width ins.	1.00	1.00
Depth ins.	1.00	1.05
Cross-sect. Area sq.in	1.00	1.05
Unit Weight #/cu.ft	140.2	139.7
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 30/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	0 hrs. @ - °F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

1361

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0010	0.01	.0090	.23	13.7	13.7
.0019	0.02	.018	.45	26.1	26.1
.0033	0.03	.027	.68	45.3	45.3
.0045	0.04	.035	.88	61.7	61.7
.0055	0.05	.044	1.10	75.4	75.4
.0068	0.06	.053	1.33	93.2	93.2
.0078	0.07	.062	1.55	107.0	107.0
.0083	0.08	.072	1.80	113.9	113.9
.0072	0.09	.083	2.08	98.7	98.7
.0045	0.10	.095	2.38	61.7	61.7
.0025	0.11	.107	2.68	34.3	34.3
.0005	0.12	.119	2.98	6.9	6.9
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

1362

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0011	0.01	.0089	.22	15.1	14.4
.0021	0.02	.018	.45	28.8	28.4
.0035	0.03	.026	.65	48.0	45.6
.0048	0.04	.035	.87	65.9	62.7
.0061	0.05	.044	1.10	83.6	79.6
.0074	0.06	.053	1.32	101.5	96.5
.0084	0.07	.062	1.55	115.2	110.0
.0090	0.08	.071	1.78	123.5	117.5
.0090	0.09	.081	2.02	123.5	117.5
.0081	0.10	.092	2.30	111.0	105.8
.0069	0.11	.103	2.58	94.6	90.1
.0048	0.12	.115	2.88	65.9	62.7
.0030	0.13	.127	3.18	41.1	39.2
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 72

Project

Code No's. T-230

Technician BPS

Date: Feb 17/56

Specimen		2301	2302
Test -- Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.in		
Test -- Tension		x	x
Width	ins.	1.00	1.03
Depth	ins.	1.01	0.98
Cross-sect. Area	sq.in.	1.01	1.01
Unit Weight	#/Cu.ft	138.6	139.3
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Huskey Pen 200-300
% Additive	0
Type Additive	-
Date Fabricated	Jan 26/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	29 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

2301

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0008	0.01	.0092	.23	11.0	10.9
.0013	0.02	.019	.48	17.8	17.6
.0021	0.03	.028	.70	28.8	28.5
.0031	0.04	.037	.93	42.5	42.1
.0039	0.05	.046	1.15	53.5	52.9
.0045	0.06	.055	1.38	61.6	61.0
.0041	0.07	.066	1.65	56.2	55.6
.0031	0.08	.077	1.93	42.5	42.1
.0015	0.09	.088	2.20	20.6	21.4
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2302

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0010	0.01	.0090	.23	13.7	13.5
.0017	0.02	.018	.45	23.4	22.2
.0021	0.03	.028	.70	28.8	28.5
.0028	0.04	.037	.93	37.0	36.6
.0035	0.05	.046	1115	48.0	47.5
.0044	0.06	.056	1.40	60.4	59.8
.0049	0.07	.065	1.63	67.1	66.4
.0051	0.08	.075	1.88	70.0	69.3
.0052	0.09	.085	2.13	71.3	70.5
.0051	0.10	.095	2.38	70.0	69.3
.0045	0.11	.105	2.62	61.6	61.0
.0935	0.12	.116	2.90	48.0	47.5
.0025	0.13	.128	3.20	34.3	34.0
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.25				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 78

Project

Code No's. T-232

Technician BPS

Date: Feb 19/56

Specimen		2321	2322
Test -- Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft.		
Cross-sect. Area	sq.in		
Test -- Tension		x	x
Width	ins.	0.98	1.07
Depth	ins.	1.03	0.94
Cross-sect. Area	sq.in	1.01	1.00
Unit Weight	#/Cu.ft	140.2	139.0
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	2.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 27/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	29 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

2321

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0008	0.01	.0092	.23	11.0	10.9
.0015	0.02	.018	.45	20.6	20.4
.0022	0.03	.028	.70	30.2	29.9
.0030	0.04	.037	.93	41.1	40.7
.0040	0.05	.046	1.15	54.9	54.4
.0049	0.06	.055	1.38	67.3	66.6
.0057	0.07	.064	1.60	78.1	77.3
.0065	0.08	.073	1.83	89.1	88.2
.0071	0.09	.083	2.08	97.3	96.3
.0077	0.10	.092	2.30	105.6	104.5
.0079	0.11	.102	2.55	108.2	107.1
.0075	0.12	.112	2.80	102.9	101.9
.0069	0.13	.123	3.08	94.6	93.7
.0059	0.14	.134	3.35	80.9	80.1
.0042	0.15	.146	3.65	57.6	57.1
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2322 O.S.

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0004	0.01	.0096	.24	5.5	5.5
.0009	0.02	.019	.47	12.3	12.3
.0011	0.03	.029	.72	15.1	15.1
.0012	0.04	.039	.97	16.5	16.5
.0015	0.05	.048	1.20	20.6	20.6
.0018	0.06	.058	1.45	24.7	24.7
.0021	0.07	.068	1.70	28.8	28.8
.0025	0.08	.077	1.93	34.3	34.3
.0028	0.09	.087	2.18	38.4	38.4
.0031	0.10	.97	2.43	42.5	42.5
.0035	0.11	.106	2.65	48.0	48.0
.0039	0.12	.116	2.90	53.5	53.5
.0041	0.13	.126	3.15	56.2	56.2
.0043	0.14	.136	3.40	59.0	59.0
.0046	0.15	.145	3.62	63.1	63.1
.0047	0.16	.155	3.88	64.5	64.5
.0048	0.17	.165	4.13	65.9	65.9
.0049	0.18	.175	4.38	67.2	67.2
.0045	0.19	.185	4.62	61.6	61.6
.0039	0.20	.196	4.90	53.5	53.5
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 79

Project	
Code No's.	T-234
Technician	BPS
Date:	Feb 19/56

Specimen		2341	2342
Test -- Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.in		
Test -- Tension		x	x
Width	ins.	1.00	1.00
Depth	ins.	1.00	1.01
Cross-sect. Area	sq.in	1.00	1.01
Unit Weight	#/Cu.ft	139.4	140.0
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Huskey Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 29/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	29 hrs. @140 °F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

#2341

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0009	0.01	.0091	.23	12.3	12.3
.0021	0.02	.018	.45	28.8	28.8
.0037	0.03	.026	.65	50.7	50.7
.0050	0.04	.035	.88	68.6	68.6
.0060	0.05	.044	1.10	82.4	82.4
.0068	0.06	.053	1.33	93.2	93.2
.0068	0.07	.063	1.57	93.2	93.2
.0050	0.08	.075	1.88	68.6	68.6
.0012	0.09	.089	2.23	16.5	16.5
.0006	0.10	.094	2.36	8.2	8.2
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2342

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0010	0.01	.0090	.22	13.7	13.6
.0019	0.02	.018	.45	26.1	25.9
.0020	0.03	.028	.70	27.4	27.1
.0005	0.04	.039	.98	6.9	6.8
	0.05				
	0.06				
	0.07				
	0.08				
	0.09				
	0.10				
	0.11				
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 80

Project	
Code No's.	T-236
Technician	BPS
Date:	Feb 19/56

Specimen		2361	2362
Test -- Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.in		
Test -- Tension		x	x
Width	ins.	1.00	1.00
Depth	ins.	1.03	1.04
Cross-sect. Area	sq.in	1.03	1.04
Unit Weight	#/Cu.ft	139.8	140.7
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	6.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 30/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	29 hrs. @ 140°F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

2361

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0005	0.01	.0095	.24	6.9	6.7
.0011	0.02	.019	.48	15.1	14.7
.0020	0.03	.028	.70	27.4	26.6
.0036	0.04	.036	.90	49.4	47.9
.0050	0.05	.045	1.13	68.6	66.6
.0067	0.06	.053	1.33	91.9	89.1
.0080	0.07	.062	1.55	109.8	106.6
.0089	0.08	.071	1.78	122.1	118.6
.0085	0.09	.081	2.03	116.7	113.2
.0070	0.10	.093	2.32	96.0	93.1
.0045	0.11	.105	2.63	61.7	59.8
.0029	0.12	.117	2.92	39.8	38.6
.0019	0.13	.128	3.20	26.1	25.3
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

2362

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0010	0.01	.0090	.23	13.7	13.2
.0027	0.02	.017	.42	37.0	35.6
.0045	0.03	.026	.65	61.6	59.2
.0065	0.04	.034	.85	89.2	85.6
.0078	0.05	.042	1.05	10.70	102.8
.0091	0.06	.051	1.275	124.8	119.9
.0105	0.07	.060	1.50	144.0	138.4
.0111	0.08	.069	1.725	151.3	145.5
.0117	0.09	.079	1.98	160.6	154.2
.0114	0.10	.089	2.33	156.5	150.5
.0098	0.11	.100	2.50	134.5	129.3
.0059	0.12	.114	2.86	94.6	91.0
.0030	0.13	.127	3.18	41.2	39.6
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 81

Project	
Code No's.	T-330
Technician	BPS
Date:	Feb 19/56

Specimen		3301	3302
Test -- Compression			
Length	ins.		
Diameter	ins.		
Volume	cc's		
Unit Weight	#/cu.ft		
Cross-sect. Area	sq.in		
Test -- Tension		x	x
Width	ins.	0.98	0.98
Depth	ins.	1.03	1.03
Cross-sect. Area	sq.in	1.01	1.01
Unit Weight	#/Cu.ft	138.8	138.6
Volume	cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	0
Type Additive	-
Date Fabricated	Jan 26/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	70 hrs. @140°F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

3301

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0009	0.01	.0091	.23	12.3	12.2
.0013	0.02	.019	.465	17.8	17.6
.0019	0.03	.028	.70	26.1	25.8
.0028	0.04	.037	.925	38.4	38.0
.0037	0.05	.046	1.15	50.7	50.7
.0048	0.06	.055	1.375	65.9	65.2
.0055	0.07	.065	1.625	75.4	74.6
.0061	0.08	.074	1.875	83.6	82.8
.0064	0.09	.084	2.13	87.8	86.9
.0063	0.10	.094	2.45	86.4	85.6
.0054	0.11	.105	2.63	74.1	73.7
.0038	0.12	.116	2.90	52.1	51.6
.0014	0.13	.129	3.22	19.2	19.1
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3302

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0012	0.01	.0088	.22	16.5	16.4
.0021	0.02	.018	.45	28.8	28.5
.0031	0.03	.027	.675	42.5	42.1
.0040	0.04	.036	.90	54.9	54.4
.0050	0.05	.045	1.13	68.6	67.9
.0058	0.06	.054	1.33	79.5	78.7
.0067	0.07	.063	1.57	91.9	91.0
.0073	0.08	.073	1.83	100.1	99.0
.0079	0.09	.082	2.05	108.3	107.2
.0070	0.10	.093	2.33	96.0	95.1
.0042	0.11	.106	2.65	57.6	57.0
.0025	0.12	.117	2.92	34.3	34.0
.0015	0.13	.128	3.20	20.6	20.4
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

T-232
BPS
Feb 19/56

Specimen	3321	3322
Test — Tension	x	x
Width	1.00	1.07
Depth	1.02	0.97
Cross-sect. Area	1.02	1.04
Unit Weight	140.0	139.3

Cement	8.0
Cement	Husky Pen 200-300
	2.0
	Polythene 119 Comm
	Jan 27/56
	Feb 19/56
Temperature	36 °F
	70 hrs. @ 140
	0.08 in/min
	600 #Cap

3321

Proving Ring	True Def.	% Str.	Load #	Stress psi
.0000				
.0016	.0084	.21	22.0	21.6
.0031	.017	.43	42.6	41.7
.0040	.026	.65	54.9	53.8
.0049	.035	.87	67.2	65.9
.0051	.045	1.13	70.0	68.6
.0050	.055	1.37	68.6	67.2
.0040	.066	1.65	54.9	53.8
.0031	.077	1.93	42.5	41.6
.0020	.088	2.20	27.4	26.8
.0010	.099	2.48	13.7	13.4

3322

Proving Ring	True Def.	% Strain	Load #	Stress psi
.0000				
.0011	.089	.22	15.1	14.5
.0018	.018	.45	24.7	23.9
.0027	.027	.68	37.0	35.6
.0034	.037	.93	46.6	44.8
.0041	.046	1.15	56.2	54.0
.0048	.055	1.38	65.9	63.3
.0052	.065	1.63	71.4	68.5
.0056	.074	1.85	76.8	73.7
.0058	.084	2.10	79.5	76.4
.0059	.094	2.35	80.9	77.6
.0054	.104	2.60	74.1	71.1
.0043	.116	2.90	59.0	56.6
.0014	.129	3.22	19.2	18.5

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ASPHALT ADMIXTURE INVESTIGATION

Sheet 83

Project	
Code No's.	T-334
Technician	BPS
Date:	Feb 19/56

Specimen	3341	3342
Test -- Compression		
Length ins.		
Diameter ins.		
Volume cc's		
Unit Weight #/cu.ft		
Cross-sect. Area sq.in		
Test -- Tension	x	x
Width ins.	1.00	1.00
Depth ins.	0.99	0.99
Cross-sect. Area sq.in	0.99	0.99
Unit Weight #/Cu.ft	139.9	139.6
Volume cc's		

% Asphalt Cement	8.0
Type Asphalt Cement	Husky Pen 200-300
% Additive	4.0
Type Additive	Polythene 119 Comm
Date Fabricated	Jan 27/56
Date Tested	Feb 19/56
Testing Temperature	36 °F
Accelerated Aging:	70 hrs. @ 140F
Rate of Strain	0.08 in/min.
Proving Ring	600 #Cap.

3341

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0008	0.01	.0092	.23	11.0	11.1
.0020	0.02	.018	.45	27.4	27.7
.0035	0.03	.026	.65	48.0	48.5
.0048	0.04	.035	.875	65.8	66.4
.0060	0.05	.044	1.125	82.2	83.0
.0070	0.06	.053	1.325	96.0	97.0
.0072	0.07	.063	1.575	98.6	99.6
.0072	0.08	.073	1.825	98.6	99.6
.0062	0.09	.084	2.10	85.0	85.6
.0041	0.10	.096	2.40	56.2	56.8
.0020	0.11	.108	2.70	27.4	27.7
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

3342

Proving Ring	Def. Dial	True Def.	% Strain	Load #	Stress psi
.0000	0.00				
.0013	0.01	.0087	.22	17.8	18.0
.0021	0.02	.018	.45	28.8	31.1
.0040	0.03	.026	.65	54.9	55.4
.0060	0.04	.034	.85	82.3	83.1
.0078	0.05	.042	1.05	107.0	108.1
.0096	0.06	.050	1.25	131.8	133.0
.0108	0.07	.059	1.475	148.2	150.0
.0111	0.08	.067	1.675	152.3	154.0
.0097	0.09	.080	2.00	133.0	134.5
.0040	0.10	.096	2.40	54.9	55.5
.0020	0.11	.108	2.70	27.4	27.7
	0.12				
	0.13				
	0.14				
	0.15				
	0.16				
	0.17				
	0.18				
	0.19				
	0.20				
	0.21				
	0.22				
	0.23				
	0.24				
	0.25				
	0.26				

T-336
BPS
Feb 19/56

	3361	3362
	x	x
	1.00	1.00
	1.00	1.03
	1.00	1.03
	139.3	139.0

	8.0
Cement	Husky Pen 200-300
	6.0
	Polythene 119 Comm
	Jan 31/56
	Feb 19/56
	36
	70 hrs. @140 °F
	0.08 in/min
	600 #Cap

3361							3362			
Proving Ring	Def.	True Def.			psi		True Def.	% Strain	Load #	Stress psi
.0000						.0000				
.0018		.0082	.205	24.7	24.7	.0012	.0088	.22	16.5	16.0
.0031		.017	.425	42.5	42.5	.0020	.018	.45	27.4	26.6
.0043		.026	.65	59.0	59.0	.0031	.027	.675	42.5	41.2
.0060		.034	.85	82.3	82.3	.0046	.035	.875	63.1	61.2
.0083		.042	1.05	113.8	113.8	.0062	.044	1.10	85.1	82.6
.0107		.049	1.25	146.8	146.8	.0073	.053	1.325	100.0	97.0
.0122		.058	1.45	167.3	167.3	.0072	.067	1.675	98.6	95.6
.0121		.068	1.70	166.0	166.0	.0055	.074	1.85	75.4	73.1
.0090		.081	2.03	123.5	123.5	.0032	.087	2.18	43.9	42.6
						.0002	.100	2.50	2.7	2.6